DOCUMENT RESUME

ED 120 012 SE 020 483

AUTHOR	Capie, William, Ed.; Fox, Fred W., Ed.
TITLE	Reflections on Science Education. 1976 AETS Yearbook.
INSTITUTION	Association for the Education of Teachers in Science.; ERIC Information Analysis Center for Science, Mathematics, and Environmental Education, Columbus, Ohio.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
PUB DATE	Dec 75
NOTE	183p.
AVAILABLE FROM	Information Reference Center (ERIC/IRC), The Ohio State University, 1200 Chambers Road, 3rd Floor, Columbus, Ohio 43212 ($4.25)
EDRS PRICE	MF-$0.83 HC-$10.03 Plus Postage
DESCRIPTORS	Elementary School Science; *Elementary Secondary Education; Inservice Teacher Education; *Science Education; Secondary School Science; *Self Actualization; *Teacher Education; Yearbooks
IDENTIFIERS	AETS; Association for Education of Teachers in Science; *Piaget (Jean)

ABSTRACT

This publication, the third in a yearly series, follows the intent of previous editions in which rapid changes in the field of science teacher education were assessed. Accordingly, 14 contributed articles appearing in this volume are grouped under the following headings: (1) The Mission of Science Education, (2) The People of Science Teaching, and (3) Teacher Training. The mission of science section is devoted to a study of science education on the elementary and secondary school levels. Piagetian theory, its application to the teaching of science, and the importance of self-actualization for both students and teachers, comprise the second main division of the publication. Six articles propose ideas concerning teacher preparatory and inservice education in the section devoted to developments in teacher training. (CP)

Documents acquired by ERIC include many informal unpublished materials not available from other sources. ERIC makes every effort to obtain the best copy available. Nevertheless, items of marginal reproducibility are often encountered and this affects the quality of the microfiche and hardcopy reproductions ERIC makes available via the ERIC Document Reproduction Service (EDRS). EDRS is not responsible for the quality of the original document. Reproductions supplied by EDRS are the best that can be made from the original.

1976 AETS YEARBOOK

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

[illegible]

REFLECT
SCIENCE

REFLECTIONS ON SCIENCE EDUCATION

ED120012

Edited by
WILLIAM CAPIE
University of Georgia
Athens, Georgia 30602

Association for the Education of
Teachers in Science

in cooperation with

The ERIC Science, Mathematics and
Environmental Education Information Analysis
Center and the Center for Science and Mathematics
Education, The Ohio State University

ERIC/SMEAC SCIENCE, MATHEMATICS, AND ENVIRONMENTAL EDUCATION INFORMATION ANALYSIS CENTER.

. . . an information center to organize and disseminate information and materials on science, mathematics, and environmental education to teachers, administrators, supervisors, researchers, and the public. A joint project of The Ohio State University and the Educational Resources Information Center of NIE.

SE 020 473

1976 AETS YEARBOOK

REFLECTIONS ON SCIENCE EDUCATION

Edited by

William Capie
University of Georgia
Athens, Georgia 30602

Fred W. Fox
Yearbook Series Editor
Oregon State University
Corvallis, Oregon 97331

Association for the Education of
Teachers in Science

ERIC Information Analysis Center for
Science, Mathematics, and Environmental Education
The Ohio State University
1200 Chambers Road
Columbus, Ohio 43212

December, 1975

The ERIC Information Analysis Center for Science, Mathematics, and Environmental Education is pleased to cooperate with the Association for the Education of Teachers in Science in producing this Yearbook, funded in part through the Center for Science and Mathematics Education, The Ohio State University.

ERIC/SMEAC and AETS are currently cooperating on a fourth publication. We invite your comments and suggestions on this series.

Stanley L. Helgeson
Associate Director
Science Education, ERIC/SMEAC

Patricia E. Blosser
Research Associate
Science Education, ERIC/SMEAC

This publication was prepared pursuant to a contract with the National Institute of Education, United States Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their judgment in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent National Institute of Education position or policy.

Foreword

The Third Yearbook of the Association for the Education of Teachers in Science reflects the continuing professional growth of the organization. Vigorous leadership from Association officers and responsible followup by the membership has made it possible for the current yearbook to be addressed to the rapidly changing concerns in science teacher education today. The first uncertain steps taken as we assembled the papers which were to be the second yearbook have been followed by the confident strides, in a clearer direction, to be found in the present volume. President Butts is to be commended for the focus he provided for this new effort. Issue Editor Capie deserves our hearty thanks for completing in excellent manner the enormous task of setting schedules, hounding writers, demanding rewrites, assembling and putting into order the final papers, and doing the hundreds of other minor tasks required in such assignments. The Association, in turn, owes a debt of gratitude to the authors and reactants who made their "reflections on science education" worthy of our earnest attention.

The yearbooks are becoming an established part of the Association's program. We will look forward to future issues.

Fred W. Fox
Yearbook Series Editor

PREFACE

Reflections on Science Education continues the format begun with the Second Yearbook of the Association for the Education of Teachers in Science. It consists of a series of papers and reactions solicited by President David P. Butts. Many of the authors were among a group of science educators who visited science education institutions in Paris, Geneva, Leningrad, Moscow, Plymouth, Southhampton and London during the summer of 1974. Among the many purposes of the trip was the desire to reflect on our own science education enterprise through examining practices and philosophies abroad.

In developing topics for the papers, President Butts encouraged the authors to work within areas of general concern and to pursue questions of their own interest. The papers which emerged do reflect the travel experience, but they have become thoughtful analyses of problems, practices and priorities in this country.

In the process of reading the papers through several editions I have grouped them in many different ways. This final product represents an attempt to examine the papers and the reactions as units before grouping and ordering them. Three groups of papers have been assembled. The first deals with the goals or "mission" of science education. The second section is concerned with the application of psychological theory to science education. The final group addresses problems in science teacher education.

Part I: The Mission of Science Education

Science education has a varied history. The last one hundred years have seen an evolution from a period of very little science at the elementary level, through periods of nature study, and practical science, and into the sixties. Science for the sixties at the secondary level emerged from a similar background into an era of science of the scientists. In many respects the 1960's may have been the hey-day of science education--massive curriculum development efforts, National Science Foundation sponsored retraining of science teachers, diverse and abundant opportunities for college science educators. Reflection on the past leads naturally to speculation about the future and the "Mission of Science Education."

Evelyn Streng indicates that we may have entered an era where elementary students are the starting points in planning curricula rather than merely targets for instruction. Her contention is that we have begun to acknowledge the need to consider affective areas in planning learning. In response, Dr. Ochs maintains that recognizing the need to attend to affective areas is not new, but that we are now facing this as a most pressing need.

Ted Mills has identified a similar emphasis at the secondary level but also sees a parallel development of integrated science. He builds a case for maintaining these joint emphases since integrating science is one way of providing the personalization he considers necessary for science education in the seventies. While agreeing with Mills analyses of the current situation, Professor Simpson doubts that science education has a mission. Rather, he claims that people have missions. Accordingly, he urges that science educators strive to understand the interaction among the people of science education--children and teachers--and between the people and the discipline.

Part II: The People of Science Teaching

Focusing on the teacher, the learner, and the teacher-learner-content interaction represents a marked departure from science education when content was the thing. Much of the change in the last fifteen years reflects the influence of various branches of educational psychology.

Nancy and William Torop contend that psychological theory can make an increasingly large contribution to education. They claim that Piagetian Theory is richest in its utility to science educators since it focuses on the child and recognizes the importance of the interaction among children in the classroom. They do acknowledge the difficulty in training teachers to operate consistently with the Piagetian model. Professor Stallings, in supporting the position of the Torops, questions the necessity of abandoning the humanistic approach in favor of the Piagetian. Instead he advocates a meshing of the two.

Marjorie King, in exploring factors that influence commitment, applies principles of third force psychology to the teacher training enterprise and to public schools in general. She advocates the exploration of commitments of all practitioners to facilitate the self-actualization of both children and teachers. She sees the process as requiring collaboration at all levels within the educational system. Professor Huntsberger attempts to translate some of King's imperatives into an action plan within the grasp of many teachers and university science educators.

Part III: Teacher Training

A host of forces has been acting on the teacher education community with increased intensity. Coupling cries for humanism and accountability with new charges for competence has produced an intense pressure for change. Meanwhile, increasing costs of new technology and of every other part of education have hindered change in this time of faltering economy and declining preservice enrollments. Even inservice education is affected by the movement toward competency. More and more states and school districts are trying to plan continuing certification and inservice training on the basis of demonstrated teacher competence. Many of these efforts require collaboration of the type described by Marjorie King. Most require more intensive and comprehensive collaboration.

William Capie and David May suggest that teacher training institutions affiliate with local public schools in designing preservice training programs. They contend that many joint programs exploit the public school rather than enhance the program for children. They maintain that both the school curriculum and the training program are improved if a broader community is involved in planning both the substance and the operating procedures of the program and in carrying out the plans. Representing a school viewpoint, Bernard and Virginia Gross affirm that collaboration must begin at the discussion and planning stage and not at the action and evaluation phase.

Jerry Horn addresses a different area of collaboration--that between small, widely scattered school districts common in sparsely populated sections of our country. He proposes regional centers to make long-range plans for a coordinated inservice program. Plans would hinge on a complete preassessment. Implementation would incorporate educational television and other media to assure transportability. Professor Ellis claims that the essential problem in urban schools is not different from that of rural schools, namely effecting an accurate needs assessment and making the program valuable to teachers. He proposes that teachers themselves be encouraged to plan a greater role in their own inservice.

Bernard Benson claims that teachers undergoing inservice form a more diverse group than do college science educators. Consequently, he says, it is difficult to determine the effectiveness of any inservice format for any individual or group. He suggests that teachers be more involved in charting their own plans. Benson disapproves of the concept of centers, claiming they engender undirectional communications. He proposes that we capitalize on the educational analogue of the ecotone of biology. The ecotone is an area where communities interface, "where the action is." Professor Fyffe, in reacting to both Horn's plea for centers and Benson's call for professional organizations filling the ecotone, raises the still unanswered question, "Who's in charge?" Indeed.

Acknowledgements

Preparation of this volume was accomplished only because many people with diverse responsibilities relinquished some of their time and adjusted priorities to include the Yearbook.

Fred Fox, editor of the Yearbook series was invaluable in helping me understand the process of working with the editorial board. Review of the papers and decisions regarding the papers were accomplished with the thoughtful assistance of Fred and editorial board members, Jim Hale, Addison Lee, Bob Brandou, Doug Roberts and Dave Ost, Chairman.

A second review involved AETS memberships. Regional presidents Darrel Fyffe, Al Nous, Anne Raymond, John Smith, Paul Joslin, and Richard Smith helped me recruit volunteer reviewers. The following AETS members agreed to review a chapter:

Frank X. Sutman
Len Tharney
Orrin Gould
Richard Moore
Jim Okey
Ken Johns
Joseph Kelly
William Brown
George Starr
John Stevens
Harold Foss
F. James Rutherford
Gladys Kleinman
Glenn D. Berkheimer
Bruce Illingworth
Edward L. Smith
Roger G. Olstad
Truman Stevens
Donald Riechard
Vincent Mahoney
R. J. VandenBranden
Michael Cohen
William Maben
Rodney L. Doran
Charles Weller
John H. Trent
Arnold B. Arons
Mariana Becker
Alan Mandell
Howard Munson
Gene Gennaro

Thank you all.

My colleagues at Georgia tolerated my preoccupation with the editorial task and provided continual support. Finally, my secretary, Martha, unflinchingly endured the extra responsibility that came her way and helped immensely with much of the communication with the people associated with this publication.

William Capie
1976 Yearbook Editor

CONTENTS

Page

PART I THE MISSION OF SCIENCE EDUCATION

The Mission of Science Education:
The Elementary School
Evelyn Streng 1

The Mission of Science Education:
The Elementary School - A Reaction
V. Daniel Ochs 20

The Mission of Science Education:
The Secondary School
Ted J. Mills 26

The Mission of Science Education:
The Secondary School - A Reaction
Ronald D. Simpson 41

PART II THE PEOPLE OF SCIENCE TEACHING

The Implications of Piagetian Theory
for Science Education
Nancy R. Torop and William Torop 46

The Implications of Piagetian Theory
for Science Education - A Reaction
Everett S. Stallings 71

Educators and Self-Actualization
Marjorie King 80

Why You're Doing What You're Doing and How!
A Response to: "Educators and Self-Actualization"
John P. Huntsberger 97

PART III TEACHER TRAINING

Collaboration in Teacher Training
William Capie and David H. May 101

Collaboration in Teacher Training - A Reaction
Bernard F. Gross and Virginia T. Gross 118

Page

Strategies for Inservice Teacher Education in Science: Problems, Practices and a Proposal
Jerry G. Horn 126

Strategies for Inservice Teacher Education in Science - A Reaction
Ronald S. Ellis 146

Inservice Education: A Model for Role Reorientation
Bernard W. Benson 156

Inservice Education: A Model for Role Reorientation - A Reaction
Darrel W. Fyffe 172

PART I

THE MISSION OF SCIENCE EDUCATION

THE MISSION OF SCIENCE EDUCATION:
THE ELEMENTARY SCHOOL

Evelyn Streng
Texas Lutheran College
Seguin, Texas 78155

Position Statement

Elementary school science in the mid-seventies appears to be shifting toward goals in the affective domain. Curricula have been structured around the content and nature of science, with emphases on subject-matter mastery and problem-solving skills. Though the student has always been the target, a more recent trend appears to be making the student the starting point for the organization of science experiences. This trend may be noted not only in the United States but in England and in the Soviet Union, as well.

A concomitant (and perhaps a stimulus) has been the involvement of psychologists in curriculum planning and the application of Piagetian understanding of cognitive development. Social and economic problems of technological societies, as well as political ideology, also have their impact on science education. Knowledge and skills are used by persons: how do they think and feel about experiences in their environment? On what basis, what value systems, will they make decisions concerning their responses and responsibilities?

Whether there is a trend toward the affective domain may be debatable. Whether this should be a priority for science education may also be questioned. To this writer the primary emphasis on developing children as persons with attitudes and values for positive social decisions is a valid and desirable change in the perceived mission of science education, though not without its dangers!

Introduction

An elementary teacher responsible for a group of lively, diverse children has little time for analysis and reflection as to the mission of science education. Simple "knowledge" goals are what many of the public (even school board members!) consider the business of education, and fact-retention is rewarded in many grading systems. However, the "revolution" in science education of the sixties caused many teachers to evaluate their traditional emphasis on subject-matter mastery and to test new approaches.

In the seventies there appear to be some ground swells that may move science education even farther in new directions. The consideration here is the ascendancy of the affective domain, expressed in concern for seeing how children perceive reality, how they feel about themselves and their experiences, and how they relate to the world of people and things around them. The intent of this paper is to examine this trend in elementary science education as it is interpreted from selected literature or as it has been observed, somewhat subjectively perhaps, also in situations abroad.

Is this change in perception of "mission" a wave of the future or is it a minor agitation? Should one hope that elementary teachers will ride along with the trend or is it one to be resisted as something that will submerge and dilute good science teaching? What factors may help to account for any such trend? Definitive answers may be lacking, but this writer believes that this is a beneficial current to carry science education, albeit with some careful steering!

HISTORICAL REVIEW

Any "trend" must take into account what has gone before. An exhaustive history of science education objectives is not appropriate here, but a glimpse of stated objectives in selected eras may be significant. Goals are always a first step for curriculum-makers, and anyone who has been part of the process knows that much committee time is spent in honing and polishing introductory statements.

Nothing as blatantly simplistic as this 1929 statement would probably come out of a committee today, but it may represent a period:

> Progressive attainment is expected of pupils from unit to unit and from grade to grade. . . .

The "General Objectives of Elementary Science" are then outlined as I. Knowledge, II. Habits and Skills, and III. Attitudes.

> When the objectives of a course are stated clearly and specifically, it is possible to set up tests at intervals to determine whether the objectives have been achieved. If the objective is to acquire knowledge the test may consist of a few questions or problems. . . .
>
> In the attainment of a knowledge objective, there are always a few significant facts or ideas which the pupil should learn permanently, just as he learns his multiplication table. There is no reason why it should not be understood by the pupil just what the essential facts to be permanently retained are. It is a knowledge of these essential facts for which the student should be tested (5:9 and 13).

In the 1940's, the late John Dewey era, Gerald S. Craig of Teachers College, Columbia, gave strong leadership in seeing the mission as more than knowledge of subject matter. In the first (1940) edition of his influential Science for the Elementary School Teacher, he phrased it this way:

> Gradually the traditional practice of thinking of a subject-matter field, such as science in the elementary school, in terms of subject-matter mastery is being eliminated in favor of thinking of an area as contributing to the child's growth in useful directions. Science, therefore, emerges in the elementary school as not so much small content to be learned but as large outcomes which may be emerging constantly in one's life as the result of the interaction of the individual with his environment in an age of science. Content must be recognized as a means, not as an end. . . Possibly the most persistent factor operating to influence the content in the curriculum today is the growing insistence that content is valuable only in so far as it meets the needs of the child and of society (7:3).

Craig stressed as important the basic working conceptions which he defined as "interpretative ideas which serve to orient the individual to the natural and social events in the universe about him" (7:8). He also noted that "Growth must start from where the children are" (7:27).

Textbook writers and curriculum makers of this period responded by rephrasing objectives in terms of "concepts," "understandings," or "generalizations." Units were organized around "problems." Some mastery of the material in the textbook continued to dominate classroom practice, nevertheless, and one could encounter situations in which children were expected to regurgitate not only "significant facts" but "concepts" as well.

Perhaps the post-war knowledge explosion had something to do with the period when upper elementary science texts became thicker and heavier as publishers almost frantically updated editions by adding chapters on atomic energy, space exploration, or other new developments. Perhaps teachers themselves became frustrated at trying to help children form concepts which they themselves never had encountered. And there was the impetus of scientists themselves -- some of whom had children in those classrooms! -- for those refreshing curriculum movements of the 1960's. Who will deny that one prime objective was a political one: ultimately to keep up with the Sputnik-launching Russians in scientific technology? How else could one explain the ready availability of NSF funds for curriculum innovation?

Fortunately, these curriculum projects also came closer to the children themselves than had some of the earlier textbooks. The first Science Education News to report on the improvements of science education notes that

> . . .one of the most promising facts apparent on the following pages is that those who know science and those who know children have worked closely together. . . all the courses have met (or will

> meet) the test of classroom teaching and have been revised in the light of criticism from teachers who know what it means to teach children rather than merely facts (2:1).

Science -- A Process Approach (SAPA) pioneered in stating objectives in terms of student behavior and suggested check-lists to record what individual students were able to do. The "hands-on" activities helped even children with poor reading skills to experience success. Children who had failed miserably on written science content tests were able to demonstrate their knowledge, for example, as to the essentials for an electrical circuit. The check-lists of observable behaviors, however, seem to ignore the affective domain. Clear, unambiguous specification of expected behavior to express interests, attitudes, values is difficult! This does not diminish the importance of such behavior. "Feeling" confident and happy about science was something which happened not only to children but also to teachers. Positive reinforcement in the affective domain may well have been a factor in the popularity of SAPA.

Meanwhile, something that had been going on in Geneva since the 1930's at last was noticed in American circles. Along Lake Geneva in the Rousseau Institute (later affilitated with the University of Geneva), Jean Piaget and his co-workers had been quietly accumulating masses of data from interviews with children which gave clues to their mental growth. Although at first there was relatively little effort to apply these findings to pedagogy, the implications for seeing how and when children form concepts became apparent.[1] In the 1960's a flood of Piaget translations and publications appeared, and the American public was introduced to Piaget in feature articles in Time (28), Saturday Review (13), and similar periodicals.

The thrust of such reports was attention to children themselves rather than only to educational psychology or strategies in teaching which had been a standard part of teacher preparation. For this writer, at least, it was an awakening to the realization that earlier assumptions about children (and consequently, pedagogy) had to be re-examined. Psychologists seeking to understand and analyze children's thinking were now seriously consulted and even involved in curriculum planning. Teachers were encouraged to listen to children's interpretation of their environment and to accept their perception at a given stage rather than to impose adult conceptual schemes for which the children were not ready. Curriculum planners, then, were considering the child's view about phenomena in order to devise appropriate growth experiences. Minnemast, Elementary Science Study (ESS), and Science Curriculum Improvement Study (SCIS) all relied upon staff psychologists. SCIS, in particular, made a deliberate effort to apply Piagetian findings. Bruner and Gagné were widely consulted.

---

[1] Personal notes, presentation by Dr. Max Haberman, Piaget Institute, Geneva, Switzerland, May 23, 1974.

In Great Britain the "revolution" in science curricula came somewhat later, but it illustrates the trend under consideration. British education has been in a process of transition since 1967. Details need not concern us here, but the rationale is significant. Warden Alan Haywood of the Portswood Curriculum Development Centre in Southampton described the transition as "change from a tightly-structured curriculum to one that is open-ended, child-centered."[2] As in the United States, science curricula in lower grades had traditionally been influenced from above, in terms of what students would be expected to "know" in order to achieve at a higher grade level.

In keeping with the new approach, a curriculum project, Science 5/13, was sponsored by the Schools Council, the Nuffield Foundation and the Scottish Education Department. The explanatory booklet, With Objectives in Mind, justifies science in the primary schools

> . . . because teachers have recognized its importance in children's lives and in their ways of learning, because children are interested in it, and because the community at large feels the need to be informed about science and so for it to form part of their children's education (23:7).

The idea of starting with the child is illustrated here. In raising the question, "What kind of science is right for children?," the point is made that

> We are concerned that through the experiences they meet children will develop attitudes of enquiry and personal responsibility. . . It is our hope that working in science will strengthen the resolve of teachers to help pupils to think for themselves and to act responsibly on their own thinking (23:7-8).

The movement away from concern primarily for facts is seen against the background of an age of rapidly expanding knowledge when it is beyond anyone's ability to know all the facts.

> We must concentrate, from the start, upon developing ways of finding out, upon communicating effectively, and upon forming favourable attitudes toward active learning (23:10).

Science 5/13 has earlier been described as exemplifying the "spirit of science." It was indicated that much cross-ocean exchange had taken place as this and our own projects, particularly ESS and SCIS, grew on opposite sides of the Atlantic.

> Nuffield and the American elementary science projects are not so concerned with revealing grand patterns

---

[2] Personal notes, Southampton, England, June 5, 1974.

> of content, but with developing attitudes of inquiry and personal responsibility through exploration (30:20-21).

Similarities in materials are apparent. Science 5/13 modules are open-ended guidelines rather than syllabi, including topics such as "Science from Toys," "Minnibeasts," "Working with Wood," "Ourselves," and "Metals." They are designated as appropriate to one or more of three stages.

Stage 1 is subdivided into transition from intuition to concrete operations (infants generally) and concrete operations, early stage. "Infant thought has been described as 'intuitive' by Piaget; it is closely associated with physical action and is dominated by immediate observation." Stage 2 is concrete operations, later stage. "In this stage, a continuation of what Piaget calls the stage of concrete operations, the mental manipulations are becoming more varied and powerful." Stage 3 is transition to the stage of abstract thinking. "It may take place between eleven and thirteen for some able children, for some children it may happen later, and for others it may never occur. The objectives of this stage are ones which involve development of ability to use hypothetical reasoning and to separate and combine variables in a systematic way" (23:32). The teacher using these materials, then, is confronted with looking first at the children to ascertain their stages of development.

Application of Piagetian theory in elementary science curricula, whether in the United States or England, does not shift goals toward the affective domain! But it may be argued that the relationship of teacher and student has changed, in that the focus is more directly on helping the child than on having the child learn science. How the learner feels about the science experience becomes an even more important ingredient for effective teaching. For example, a headmaster at a British Primary School indicated that no textbooks are used in his school lest science become too academic; rather, the program is developed from ideas and "experiences which are meaningful!"[3]

In the midst of highly developed technological societies caught up in problems of urbanization and industrialization, the person of learner has become a prime concern.

---

[3] Personal notes, interview with Brian Stephens, Widey Court Primary School, Plymouth, England, June, 1974.

REVIEW OF SELECTED LITERATURE AND OTHER SUPPORTIVE EVIDENCE

Goals Focusing on the Person of the Learner

As the decade of the 1970's moves on, it appears that we are moving from goals described in terms of science objectives to broader human development and social value objectives. Perhaps the incipient idea is found in the NSTA Position Statement on "School Science Education for the 70's":

> The goal of science education should be to develop scientifically literate citizens with the necessary intellectual resources, values, attitudes, and inquiry skills to promote the development of man as a rational human being (21).

We note that the rational human being is the ultimate desired product.

Herbert Thier, associated with SCIS, suggests that cognitive development theory brings the focus on the child:

> Much of the research done by Piaget and his followers indicates the absolute necessity of (this) early concrete experience if the child is to have the capacity to react to and internalize the abstractions introduced later.
>
> The acceptance of such a point of view clearly demands a science program in which the child is intimately and actively involved with the real objects and systems which make up the environment. The actions of the child are the focus of the program, but they should not be random and unstructured (27:71).

The same idea is stated rather clearly in a 1974 text for preservice elementary teachers:

> How can science in the elementary school help the child today, tomorrow, and in the future? Why should science be taught in the elementary school? . . . research in developmental psychology and science education has given us a fundamental reason why science should be a part of the child's elementary school program: science can provide the child with some of the experiences necessary for the attainment of formal thought, a topic that has been the subject of research of one of the world's leading psychologists, Jean Piaget. . . .
>
> Formal thought is not normally attained by the elementary school child; however, the elementary school can provide the child with experiences that

> will help him attain formal thought. The attainment of formal thought is a goal of education; this goal must permeate the entire elementary school program, including the science program (10:2-3).

Focusing on the child is not limited to development in the intellectual domain; the affective domain is also significant.

> These materials [SAPA, SCIS, ESS, et. cetera] were designed to shift the teaching emphasis from repeatable knowledge (what students can say afterwards) as the primary focus in the classroom to a focus on what students are doing cognitively (the mental operations involved) and how students feel about it (their attitudes toward science) (14:51).

Writers in Science and Children make a strong plea for elementary science as a "facilitator of selfhood":

> There is a body of knowledge, a discipline, called science. However, I'm not sure of its total relevance if taught only as such. It seems particularly irrelevant, even at the secondary level, if something first hasn't happened to the learner. If we have the foresight and courage to use science in the schools more as a vehicle to self-knowledge, and less as an unalterable body of knowledge to be learned, we can do the learner a valuable service. We can create atmospheres in classrooms in which the emotional development of children is not only allowed to take place, but is encouraged to take place, and is actively sought (15:24).

The importance of the child's "self-concept" in the science classroom is emphasized by other writers:

> We, as teachers, have an innate responsibility to help each person who comes within the sphere of our influence to elevate and solidify his self esteem. In no other way can we contribute as meaningfully to the growth of our society (19:16).

Research reports such as "A Study of Self-Perceptions Among Elementary School Students Exposed to Contrasting Teaching Strategies in Science" further illustrate the trend (25). Perusal of recent files of professional magazines reveals a significant number of articles dealing with individualization and humanization, some of which may be related to the concern for persons. For example,

> . . . the learning of science proceeds in a meaningful way for all students when the emphasis is redirected from science to children. When we teach children, they learn (18:43).

Some current materials for teacher education reflect concern for the kind of person the prospective teacher is, as well as the competencies which the teacher exhibits in identifying a child's level of learning and developing appropriate activities.

> . . . a curriculum in use is not merely a "thing" or a set of written materials. It is most importantly a person: the teacher (11:2).

Ivany describes a number of models of teaching. The adoption of a model, he says, must be based on values and ideologies or even concepts of the organization of future society. He recognizes the difficulty of dealing with such intangibles:

> The affective domain is the current educational catchword that concerns, at least, goals that are as old as education itself -- those related to education in values. Value education was a critical concern of Dewey and his followers, as indeed it must be to all who aspire to teach. Dewey was more concerned with the broad and complex issues of teaching for moral citizenship than with the attempt to spell out minute, measurable behaviors. And it is precisely these "unmeasurable" behaviors that fall into disrepute during periods that emphasize behavioral objectives or performance accountability. It is too easy to pay attention only to those objectives than can easily be spelled out and measured rather than to worry about intangibles (11:328-329).

Professionals who struggle with competency-based teacher education are aware of the importance of those unwritten "intangibles" relating to teacher attitudes and feelings. Analyzing the success of a science lesson by a check list of behaviors may involve such "affective" questions as:

> Target Four -- Motivation
> How much were the children interested in the topic of the lesson?
>
> Target Five -- Rapport
> How well did the teacher like the children, and how well did the children like the teacher?
> (4:68)

Programming at NSTA Conventions has also illustrated concern for the personal dimension, including the affective domain. Anthropologist Ashley Montague, featured speaker at the 1973 Northeastern Area Convention in Boston, encouraged the audience of science educators to think of themselves as "teachers of human beings." At the same meeting President Leslie Trowbridge gave a status report on science education in which he characterized the 1970s as giving "increased attention to feelings and attitudes, to human beings, good self-concept, and values."[4]

The 1975 National Convention in Los Angeles featured "Hopeful Handles"; it may be noted that "hopeful" as defined represents a feeling! Seminars, workshops, and sessions were available on topics such as the following:

> Biology, Society, and Ethics
> The Conflict of Values in Science
> Science and Values: In Conflict or in Concert?
> Attitudes and Value Questions
> Teaching and Attitude Change
> Technological Progress and Human Values (20)

In summary, goals which focus on the person call attention to feelings, attitudes, and values of the teacher as well as the child. This awareness appears to be a trend in viewing the mission of science education.

Development of Social Values

In the foregoing there has been no clarification of what attitudes or values are to be developed. The thesis is particularly that social values, promoting the welfare of humanity, are becoming more prominent than distinctively personal values and attitudes.

"Citizenship education" has been traditional in America, illustrated by science goals such as "to develop attitudes of conservation." The NSTA Position Statement also referred to "scientifically literate citizens" (21). More recently, an advertisement for the revised Science -- A Process Approach II claims that

> It helps prepare children for useful, effective citizenship in an increasingly complex and technological society (24).

It appears that scientific literacy and effective citizenship imply decision-making. In "Education for Scientific Literacy," Michael L. Agin (1) postulates three primary purposes of science education. Relevant here is the third, "to provide individuals with a background in science as a part of their general education for effective citizenship." However, this is interpreted as follows:

> Our task is to develop programs and practices that reflect our knowledge of the way science influences society, the way society influences science, and the importance of these knowledges to every citizen who wishes to participate actively in making social decisions that are auspicious when judged on the

---

[4] Personal notes, Boston, Massachusetts, 1973.

> basis that benefits to be derived will be significantly greater than the risks implied. The management of the environment of man by man must assume a posture for the future as well as the present (1:403, 415).

Recently, David J. Kuhn called for a new direction in science education, which he calls "Value Education in the Sciences: The Step Beyond Concepts and Processes." The social implications of science, with an emphasis on student opinions and judgments, are to be fostered. The approach to valuing is described as new to most science teachers (16). But others have said this in different ways, for example, ". . . science teaching tomorrow must be the teaching of a value system to deal effectively with what is known today" (6).

That elementary-school students are encouraged to make responsible decisions in relation to the environment is surely illustrated in ecological/environmental education. Making a "litter census" as an elementary science activity is something unheard of a decade ago but now seems like a good idea. Science and Children and other periodicals are full of reports which illustrate activities to build attitudes and give children practical decision-making opportunities. Values of benefit to society are supposedly being shaped by the "science" experiences.

A curriculum development which illustrates the importance of decision-making is Unified Science and Mathematics for Elementary Schools (USMES). Its major purpose

> . . . is to provide elementary school students with opportunities to investigate and solve real and practical problems in their school and community environment (8:10).

Decision-making takes a step beyond problem-solving. In a classroom where children may be in control of the variables which they manipulate to solve a problem, poor judgment causes little damage. For relevant problems that grow from immediate social concerns it is not possible to manipulate all the variables; situations are much more complex. The quality of human life is involved! Long-range effects also are often unpredictable. When no hard data are available, decisions will involve some feelings or value judgments. Will the "solution" favor a particular group in power, or will it promote the welfare of most citizens?

Though elementary school years seem crucial for shaping positive social values for later effective decision-making, research is lacking as to the permanence of such attitudes and values for which children may exhibit enthusiasm. As Ibrahim Saadeh has pointed out,

> Though scientific attitudes constitute an important objective of science education, it is apparent that few investigations have been done in this area. . .

> One cannot help but agree with Nay and Crocker when they say: "The affective growth of students in the science classroom is virtually ignored. . ." (22:251).

The interdisciplinary approach to value decisions has been suggested by various writers, for example, Gennaro and Glenn. They recommend that science and social studies teachers work together. Curricular materials and teaching strategies with emphasis on scientific reasoning, investigative experiments, and a reliance on scientific knowledge reflect the ideals and goals of the previous decade; they state

> Within the past few years, however, important issues have been raised by students in science classrooms that have caused many science teachers to re-examine what is being taught in science classes. For example, today's students are not only interested in the examination of the scientific principles and concepts involved in the study of ecology but also are interested in what should be done to control the ever-increasing amount of pollution. Science teachers are asked questions that go beyond the academic study of a particular science discipline. More and more teachers find themselves discussing topics and questions that raise important value decisions for both the student and the larger society. . . . (9:93).

In conclusion, the authors suggest a new direction through this interdisciplinary approach:

> The demand for relevancy in today's science curriculum calls for improved curriculum materials, teaching strategies, and a focus on values and value questions (9:92).

In the Soviet Union the use of education for development of social values in conformity with political ideology is particularly striking. The USSR clearly proclaims this about its educational system in the UNESCO "Exposition Internationale de Education" in Geneva. There photos and samples of children's school work illustrate "The Ideas of Lenin Triumphant."

Lenin is said to have observed in 1920 that "the school, apart from life, apart from politics, is a lie and a hypocrisy" (12:50).

It appears that the Soviet child is learning in conformity with decisions as to what is good for society, decisions which someone in power has already made. The American child is encouraged to grow in the ability to make decisions for social well-being. In spite of fundamental differences, Soviet and American schools alike have gone through science curriculum revisions.

An official publication on the Soviet educational system has this rationale for the new curriculum:

> The programme schedules have been drawn up with a view to the achievements of modern science and its major spheres of development, to its growing role in the technical revolution and in the development of society. . . There is a close relationship between school work and real life.
>
> One of the most serious short-comings of the former programme schedules, which has now been done away with, was the fact that major stress was placed on descriptive material in all grades up to the 8th, without sufficient theoretical generalization. . .
>
> At the same time, the new programme schedules take into consideration the different needs of each age group and its ability to comprehend theoretical material (17:37-38).

One may note here the response to the increasing importance of science in society, as well as a concern for concept-formation in preference to accumulation of knowledge. Piaget is not mentioned but some awareness of mental capabilities at various levels is implied.

That the primary goal of all Soviet education is to serve societal purposes was reinforced for the People-to-People delegation at a Conference in the Friendship Palace in Leningrad. "The difference between Societ and U. S. education is based on the philosophic basis for understanding personality development," said Professor Ivan Syroyezhin. "The image of the human being is the result of the social circumstances he was brought up in and his experience." Professor Syroyezhin then outlined three "processes" in this personality development. First is investment in the material environment (as equipping and building schools) to provide an environment free of trauma as the first step for a sound human being. Second is to work with students to build confidence for themselves, to build ideology. Third is to give the human being skill, knowledge, for service. Service to society emphasizes practical training so that everyone can see what kind of useful man he can be.[5]

It was difficult to find out specifically what is going on in elementary science education in the USSR. It appears from conversations that nature study is most characteristic. "Education in the USSR" confirms this, noting that group excursions to the outdoors and personal observations by students make up a regular part of the course. Attitudes to be cultivated include "the preservation of wild life." In addition, we read that

---

[5] Personal notes, Leningrad, May 27, 1974.

> Shop lessons teach the children arts and crafts; they also learn to make scale models and learn the fundamental uses of electricity. There are outdoor classes on the school garden plot where they lay out vegetable beds, prepare them for sowing and conduct simple experiments in botany. Children in rural areas spend somewhat more time working on the garden plots than city children (17:39).

What the elementary schools themselves may lack in exciting "discovery" activities is supplied to some extent by the Young Pioneers organization (ages 9-14). (There are said to be 3,948 Young Pioneer community centers as of mid-1974.) A visit to such a center in Moscow showed rooms for plant cultivation, rearing of birds and other animals, photography, etc., and gave evidence also of an astronomy club. Nature clubs, technical hobby clubs (such as model rocketry), and hiking clubs with a geology interest have been described as well. These after-school activities, under the supervision of adults with particular interests and skills in these areas, are state-subsidized; in effect, they must be considered part of the educational system. Professor Syroyezhin so indicated this. The membership in the Pioneers is not obligatory, but it is a preparation for membership in the Young Communists. The purpose of the center was described by the director (in translation) as keeping children busy, to be interested in something; to try to develop different gifts and talents; to give them a collective bringing up, to care about other members. Although it was stated that it is a "non-political" organization, the director admitted that "it gives some political education." The large statue of Lenin in the entrance hall and other materials on display gave evidence of that.[6]

Whether in school or in clubs, it is clear that science activities serve an ideological purpose. Education in the USSR states about physics,

> The study of this course helps to reveal the essence of a number of dialectical and materialist philosophical concepts (17:44).

Also,

> The study of biology is begun in the 5th grade. . . The entire course is based on the principles of the theory of evolution. . . The study of botany, zoology, and physiology in the lower grades presents an introduction to the development of the organic world in conformity with Darwin's teachings on the origin of man. . . All of the above is of great importance in forming the pupil's outlook (17:45).

---

[6] Personal notes, Moscow, May 31, 1974.

Shaping the affective domain in personal development for society's purposes seems particularly the mission of Soviet (science) education. At least at the elementary level, the sciences are a means to this end.

> Soviet schoolchildren receive scientific information in all school subjects. . . This provides them with a Marxist-Leninist, materialistic outlook (17:48).

A recent issue of Soviet Life features the story of a man who "devoted his life to children" in his innovative teaching. For this Vasili Sukhomlinsky received the "Hero of Socialist Labor" title and was elected a member of the USSR Academy of Pedagogical Sciences. He wrote two books about his experiences.

> In both books the educator talks of the Soviet school as a character builder. He elaborates a whole system of methods for the education of a child in a society that is building communism. He defines the communist ideas that teachers foster in their young pupils as 'noblest human anxiety for the good of all the working people of the world'. . . He wanted all teachers to make the human being the major subject of study, to respect their pupils as human personalities. . . Out of this attitude develops the ability to do what is useful for society (29:31).

In retrospect, it is evident that any extensive movement in viewing the mission of education as building attitudes and social values is not without its hazards. Who determines what the desirable values are to be? How are conflicts in values resolved? Will the integrity of a discipline be sacrificed for the sake of the "value"? The example of science education in the Soviet Union deserves careful study.

Summary and Comment

Selected examples from the literature and from personal experience have been cited to suggest a shift from cognitive goals to goals in the affective domain. "Good teaching" has always been concerned with the student and the perceived good of society, but these concerns have not always been prominent in the statements of objectives of science education.

When the focus is on the thinking, feeling, valuing person, science becomes a vehicle for achieving goals beyond itself rather than intrinsic to itself. There is then no inviolate content which must be taught. This seems to be illustrated most clearly in the Soviet Union, where those aspects of science which will advance the purposes of the political-ideological system are favored. In Western democracy which traditionally prizes individual freedom, there is justifiable hesitance in introducing into curricula values which may reflect a choice from among controversial positions. Yet in real life such choices must be made. Can American schools be as effective in building concern for the welfare of all as the Soviet system appears to be?

Another question concerns the influence of socio-economic factors on the perceived mission of science education. Though this relationship is not the major concern of this paper, some remarks seem pertinent. To what extent have societal problems in the inner city, between alienated groups, focused the attention of science educators on the need to look first at children? More recently, it appears that fast-moving national political events have spotlighted "character" or "values" as being more crucial to our political survival than either knowledge or skills. The American public schools, by consensus, have not scored too well.

> Although training for responsibility by giving responsibility clearly begins in the family, that institution that has probably done the most to keep children insulated from challenging social tasks in the American school system. . . In terms of content, education in America, when viewed from a cross-cultural perspective, seems peculiarly one-sided, emphasizing subject matter to the exclusion of another fundamental aspect of the child's "upbringing" or "character education". . . however, the corresponding terms are the names of what constitutes the core of the educational process: the development of the child's qualities as a person--his values, motives, and patterns of social response (3:60).

How are stages in the technological development of a nation reflected in its purposes for education? A great change in the Soviet system came in the shift from an agrarian society to an industrialized society--or was the impetus totally political? In the United States it may be said that our earlier agrarian society produced people who knew who they were, and who were directly involved with and concerned with other human beings as such. With the coming of technology and the rapid expansion of knowledge, it may be that knowledge for its own sake seemed all-important as the key to progress. At a certain level of technology, knowledge outgrew the capacity of individuals to absorb it. Specialization proliferated. Then came a phase of trying to build the skills to produce more knowledge ("process"), with concentration on methodology rather than meaning. In all this absorbing concern with knowledge and skills there came de-personalization. Self-knowledge was lacking, somehow, and various groups in an expanding population also became alienated from each other. So there came a call for values and attitudes to rebuild human relationships that have been fractured in the growth of the sprawling urban complexes.

However one might seek to explain changing viewpoints as to the mission of (science) education, it appears to this writer that the trend herein suggested is a hopeful one. Published curriculum guides may not be as significant as are teacher attitudes. How can a teacher help children build not only useful knowledge and skills, but become persons who "want" to use skills in future-oriented decisions for the benefit of society? The elementary science educator must look beyond details of technology and check-lists of competencies to children and their attitudes and values for the world.

Long ago the question was asked, "What does it profit a man if he gain the whole world and lose his own soul?" Although the word is hardly to be expected in current Soviet terminology, the teacher Visili Sukhomlinsky is said to have called Soviet teachers "the creators of the human soul" (29:31). And in a civilization that now has the knowledge (concepts) and the skill (process) to blow itself into oblivion, it seems there has to be something more as the primary concern of science education. Perhaps it is time to speak not about "Science and Children" but "Children and Science for Society."

REFERENCES

1. Agin, Michael L. "Education for Scientific Literacy: A Conceptual Frame of Reference and Some Applications," Science Education, 58:403-415, July-September, 1974.

2. American Association for the Advancement of Science. Science Education News. Washington, D.C.: AAAS, December, 1961.

3. Brofenbrenner, Urie. "The Origins of Alienation," Scientific American, 231:53-61, August, 1974.

4. Butts, David. The Teaching of Science: A Self-Directed Planning Guide. New York: Harper & Row, Publishers, 1974.

5. City of Baltimore, Department of Education: Elementary Science Course of Study for Grades Four, Five, and Six (Tentative Manual), 1929.

6. Commission on Science Education. American Association for the Advancement of Science, "Science for Society, Education Review," Vol. 2, No. 3, November, 1972.

7. Craig, Gerald S. Science for the Elementary School Teacher. New York: Ginn and Company, 1940.

8. EDC News. Issue No. 6, Spring 1975, Education Development Center, 55 Chapel Street, Newton, Mass. 02160.

9. Gennaro, Eugene D. and Allen D. Glenn. "Science and Social Studies: An Interdisciplinary Approach to Values and Value Decisions," Science Education, 59:85-93, 1975.

10. George, Kenneth D., et al. Elementary School Science, Why and How. Boston: D. C. Heath, 1974.

11. Ivany, J. W. George. Today's Science. Chicago: Science Research Associates, 1975.

12. Jacoby, Susan. "Reforming Soviet Education," Saturday Review/World, December 4, p. 50, 1973.

13. Jennings, Frank A. "Jean Piaget: Notes on Learning," Saturday Review, May 20, pp. 81-83, 1967.

14. Johnson, Roger T., Frank L. Ryan and Helen Schroeder. "Inquiry and the Development of Positive Attitudes," Science Education, 58:51-56, 1974.

15. Klein, Judith S.. "Elementary Science: Facilitator of Selfhood," Science and Children, pp. 23-24, April, 1974.

16. Kuhn, David J., "Value Education in the Sciences: The Step Beyond Concepts and Processes," School Science and Mathematics, LXXIV:582-588, 1974.

17. Kuzin, V. P., M. I. Kondakov, P. V. Zimin, et al. Education in the USSR, Moscow: Progress Publishers, 1972.

18. Martin, David J. "Individualizing Junior High Science," The Science Teacher, pp. 43-45, March, 1975.

19. Mixer, Anthony S. and James L. Milson. "Self-Concept in the Science Classroom," School Science and Mathematics, LXXIV:16-21, 1974.

20. National Science Teachers Association. National Convention, Final Program; Los Angeles, March 21-24, 1975.

21. NSTA Committee on Curriculum Studies. "School Science Education for the 70's," Washington, D.C.: National Science Teachers Association, 1971.

22. Saadeh, Ibrahim. "Direction of the New Science Curricula: An Appraisal and an Alternative," Science Education, 57:247-262, 1973.

23. Schools Council. With Objectives in Mind, Science 5/13 (Trial Edition), London: Macdonald & Company (Publishers) Ltd., 1969.

24. "Science - A Process Approach II. The Modular Science Curriculum," Brochure M16921, New York: Ginn and Company (undated).

25. Shymansky, James A., Charles C. Matthews, Ronald G. Good, et al. "A Study of Self-Perceptions Among Elementary School Students Exposed to Contrasting Teaching Strategies in Science," Science Education, 58:331-341, 1974.

26. "Society and Children." Soviet Life, No. 6 (213), p. 57, June, 1974.

27. Their, Herbert D. Teaching Elementary School Science, Boston: D. C. Heath, 1970.

28. Time. "Jean Piaget: Mapping the Growing Mind," December 12, pp. 61-62, 1969.

29. Tsyupa, Ivan. "I Have Given My Heart to the Children," Soviet Life, No. 4 (199), p. 31, April, 1974.

30. Werner, Ben Jr. "Parallel Evolution of Elementary Science Programs in Great Britain, Japan, and the United States," Science and Children, pp. 20-21, December, 1972.

THE MISSION OF SCIENCE EDUCATION:

THE ELEMENTARY SCHOOL

V. Daniel Ochs
McGuffey Lab School
and
Miami University
Oxford, Ohio 45056

A Reaction

John Foster Dulles once said, "The measure of success is not whether you have a tough problem to deal with, but whether it's the same problem you had last year."

In her opening statement, Dr. Streng makes the point that "From earlier emphasis on subject-matter mastery and problem-solving skills, there is a tendency in the direction of science experiences primarily for personal development and formulation of socially desirable goals" (p. 1). The direction that science education has taken during the forties, fifties, sixties, and even thus far into the seventies has been primarily a reaction to the socio-economic-political environment. In the forties, it was the war effort; in the fifties, it was a reaction to the scientific technological explosion; in the sixties, it was Sputnik and the Russians; in the seventies, it appears to be individual rights. Each decade has produced its own Zeitgeist and science education has been bent or twisted to conform to each of these ephemeral spirits.

To what end are we evolving? Just as an anlagen, those few cells that will become an organ or piece of tissue, may be removed, destroyed, changed chemically or altered in some other way and the whole organism therefore changed, so, too, we may look at the development of our society, of science, and of the individual. We can allow the anlagen to develop as it may, subject to the forces of its environment, or we can change or guide the forces causing the anlagens of science, society, and even the individual to change in given, somewhat predetermined directions. There is some danger in this. We may see a Brave New World, or a 1984, but more likely, having been alerted to the worst, the result would be something of a lesser extreme that may benefit all of mankind. Science and technology are at once both directed and giving direction. While science must be responsive to the needs of society, it must also exert influence over the direction society and the individuals take. We must recognize this fact and account for it in any statement on the Mission of Science Education. It appears we have taken one into account, but the other has either not been identified or it has been identified and set aside while once again the mission of science education reacts to a wind that will soon be spent.

The literature is replete with statements concerning modern day movements in education. The apparent fact that the mission of science education is evolving toward more consideration of experiences for personal development and formulation of socially desirable values has been well documented by Dr. Streng's literature search. A historical review of the literature would, however, show the presence of concern for personal development and values clarification in nearly every decade. Her historical review has done this. These goals have either been ignored or brushed aside as more pressing problems surfaced and forced our mission into a mold.

Dewey, in *The Child and the Curriculum* (5) and *Experience and Education* (6), wrote of growth of the individual, personal experiencing, and dealing with the individual. Other of Dewey's contemporaries wrote similarly. Boyd Bode (2) alluded to a concern for individual differences and the teaching of values. Harold Benjamins' *The Saber-Tooth Curriculum* (1) poked fun at traditional education and affirmed the basic premises underlying the Progressive movement.

According to Cremin's classic account of the Progressive Era, its premises were

> . . . part of a vast humanitarian effort to apply the promise of American life . . .
>
> . . . it meant broadening the program and function of the school to include direct concern for health, vocation, and the quality of family and community life. . .
>
> Second, it meant applying in the classroom the pedagogical principles derived from new scientific research in psychology and the social sciences.
>
> Third, it meant tailoring instruction more and more to the different kinds and classes of children who were being brought within the purview of the school (4:viii).

The progressive movement was not only one of an educational nature, but also was political, industrial, and social. The same can be said for the humanistic movement today. The movement derived strength from a scientific front consisting of advocates of new developments in testing and measurement techniques; the unfolding of a new psychology; and a philosophy that was, in part, derived from the ideas of Rousseau, Herbart, Froebel, Spencer, and Darwin. Much the same can be said today of curriculum and instructional innovations.

Perhaps the overriding cause for the demise of the Progressive Movement is found in its inability to remain progressive. Once practices became successful, they became patterns for the future--a tragic mistake, because the movement was to a large extent based on the assumption that a curriculum should be based on the needs and interests of the individual child. These needs and these interests must certainly vary with the individual and change with the times. They could not have done so in a patterned situation.

This knowledge should alert us to the possibility of making a similar mistake. A strength of the Federation for Unified Science Education (FUSE) is that

> the concept of modularity is basic to the Unified Science approach because it implies that each module within a unit is subject to eventual replacement. The whole unit is modular in that it, too, is subject to review and replacement (9:25-27).

We can see a modular format also being taken into account by the ISCS and ISIS programs, though it is doubtful that new modules will continue to be developed after the projects become commercial and support money for the projects ends.

It is time now to turn from our brief historical perspective to an accounting of the future--the Mission of Science Education. Just as the purposes of elementary, middle school, high school, and college education differ, so too does the Mission of Science Education differ at each level.

Elementary education has for many years been the focal point of developing the "necessary" skills for life in our society. Reading, writing, and arithmetic are basic. Over and above this the skills of observation, measurement, classification, communicating, using space-time relations and others are considered necessary. These skills "can be translated into immediate behavior by the child as he attempts to understand the phenomena of science encountered on his environment" (7:12).

Some decry that:

> Problem-solving has been more information getting and question answering than it has been a process of exploring the natural environment to find questions that might be asked of nature (8:37).

But, what questions do we ask of nature? Some would have children ask questions that a scientist would ask.

Others view the elementary school goals somewhat differently. As Katherine Hill so aptly put it:

> . . . Commitment must be in terms of children, not in terms of science. They (the curriculum developers) know that boys and girls need assistance in the continuous process of building those abilities needed in interpreting natural phenomena in the environment. If this is the answer to why science in the elementary school, then this is also the criterion to be employed in determining what skills and concepts of science shall be taught (7:12).

In short, she believes the first commitment is to the children, the second to science and the ways of the scientist. The first Mission of Science Education then must be to aid children in gaining skills necessary for interpreting their environment, for gaining additional knowledge as the need arises, and for placing this knowledge in a conceptual framework.

As an aid to interpreting the environment and in effective use of appropriate knowledge, we are probably failing miserably. In spite of our attempt to create miniature scientists, children are growing up not able to interpret their environment, but rather frustrated by it and, perhaps, blaming the scientific-technological communities for this frustration. This is certainly one explanation for decreasing enrollments in secondary science.

If indeed Dr. Streng's assessment of direction is correct for the elementary school, it appears to be equally correct for the secondary school. Taba (10) cites three functions of the school that are seen by diverse elements of our society:

(1) Preserver and transmitter of cultural heritage,
(2) As an instrument for transforming society (social reconstructionist), and
(3) As an instrument for developing the individual.

Each of these functions has at one time or another held its place as the most important school function, but each has always had its following among curriculum developers and members of society.

Presently the concern for the individual has renewed interest. Such programs as IGE and Project Plan, to name two general approaches, and Nuffield Science and ISIS, to name science programs specifically, attempt to account for the individual.

To what end do we educate? Paul Brandwein's (3:131) answer is

> . . . compassion and competence. Even a casual study of history shows us that competence is not enough. The educated person has feeling as well as skill. This is not to derogate competence. Too often, we assume that other goals must negate competence in mathematics, or linguistics, or science, or art. Competence in these and in the other arenas of human knowledge is good; but it is not sufficient of itself. The educated person understands the humanness of human beings.

Brandwein continues by stating that we educate to the concept of proper action: to interpose evidence, reason, and judgment between impulse and action.

There may be a criticism in Dr. Streng's citation of the NSTA Position Statement on "School Science Education for the 70's." The statement reads:

> The goal of science education should be to develop scientifically literate citizens with the necessary intellectual resources, values, attitudes, and inquiry skills to promote the development of man as a rational human being.

If we are to take into account Brandwein's statement, we would add "to understand man as an emotional animal."

There are many facets to be considered in a mission statement. We cannot exclude processes; we cannot exclude content; we cannot exclude values. Yet, to teach values overtly may alienate a large sector of the public that ultimately supports the schools and us. Issues such as birth control, right to life, genetic manipulations, and city planning, to name out a few, are topics of a volatile nature. We cannot exclude the updating of materials and methods. If we are to be most effective in our teaching and our curriculum development, then the statement that "science teaching tomorrow must be the teaching of a value system to deal effectively with what is known today" must be changed to read "science teaching tomorrow must be the teaching of a value system to deal effectively with what is known tomorrow." We cannot exclude any of the many facets that impinge on science education if our mission statement is to be any more than a temporary breath of fresh air.

Certainly we must look to individualization. History reveals the concern for individualization is not new, but a persistent problem that is becoming more evident. Is every man, in the end, an island? I think not. If no man is an island, then social as well as individual goals are to be nourished. We may in the end find that what we thought to be an individual commitment was, after all, a social commitment. If each of the facets of a mission statement is dealt with separately and not seen as part of the whole then our mission will continue to develop piecemeal. We must look beyond individualization as a statement of mission; we must look beyond content as a mission; we must look beyond process as a mission; we must look beyond values as a mission. We must look beyond the influence that society has on science; we must look beyond the influence of science on society. We must simultaneously look at all these things and more, for if each of the facets of a mission statement is dealt with separately and not seen as part of the whole, then to rephrase Dulles statement, next year, very likely, we will have the same problem we had last year, and that would be a measure of no success.

REFERENCES

1. Benjamin, Harold. The Saber-Tooth Curriculum. New York: McGraw-Hill Book Company, Inc., 1939.

2. Bode, Boyd. Modern Educational Theories. New York: Vintage Books. (Originally published 1927 by the Macmillan Company)

3. Brandwein, Paul. "Skills of Compassion and Competence," Life Skills in School and Society. Washington, D.C.: Association for Supervision and Curriculum Development, 1969.

4. Cremin, Lawrence. The Transformation of the School. New York: Random House, 1961.

5. Dewey, John. The Child and the Curriculum. Chicago: The University of Chicago Press, 1902.

6. Dewey, John. Experience and Education. New York: Collier Books, 1963.

7. Hill, Katherine. "Science for Children - Why?," Science and Children, p. 12, May, 1966.

8. Hurd, Paul DeHart. New Curriculum Perspectives for Junior High School Science. Belmont, California: Wadsworth Publishing Company, 1970.

9. Showalter, Victor M. "The FUSE Approach," The Science Teacher, pp. 25-27, February, 1973.

10. Taba, Hilda. Curriculum Development. New York: Harcourt Brace and World, 1962.

THE MISSION OF SCIENCE EDUCATION:

THE SECONDARY SCHOOL

Ted J. Mills
Oklahoma State University
Stillwater, Oklahoma 74074

Position Statement

The mission of secondary school science in the 1970's appears to be characterized by an increasingly high priority being assigned to attaining the goals of personalizing and integrating the secondary science curriculum. It is the author's contention that this emphasis currently exists and should continue to exist as a major factor determining the nature of secondary school science in the future.

The intent of this writer is to present a point of view supported by selected literature and personal observations of secondary science education in England, the Soviet Union and the United States.

Introduction

The process of stating goals for science education by professional associations, branches of the military, various industries, philanthropic organizations, individual scientists, and science educators, as well as by the "man on the street" is characteristic of education in the United States. Science education in the United States has no formalized national policy, central administrative control, or "official" curriculum. The law of the land is for each community, under authority delegated by the state government, to provide free schools. The responsibility for determining the goals to be attained and the means of attaining them is centered primarily at the local level. National support and guidance has been made available to a significant degree, but primarily when a crisis is perceived (14:93).

Richardson (25:7) recognized the following three general periods since science became a significant part of the curriculum:

1751 - 1872	-	Practical and expository
1872 - 1900	-	College preparatory
1900 - 1957	-	Evolution from college preparatory to functional concern for the place of science in the act of living

The evolution from an academic, college preparatory, secondary school science curriculum to one more practical and functional was slowed by the shortage of scientists and technically trained personnel in the United States in the early 1950's.

In the late 1920's a somewhat similar trend was observed in the Soviet Union. Economic pressures for highly skilled technical personnel grew and shifted the focus of Soviet education toward utilitarian goals in the early 1930's. The result was an insistence that the secondary schools concentrate on the transmission of a structured body of technical knowledge (13:359).

John Dewey, after visiting the Soviet Union in 1928, observed that the Russian schools were more democratically organized than their American counterparts (6:66). Dewey's work was praised by Soviet educators and the study of his writings was encouraged. After 1931, however, the progressive movement in the Soviet Union was virtually dead.

British science education from 1900 to 1936 placed considerable emphasis on physics and chemistry. Physics was usually confined to the systematic study of mechanics, heat, and light, while chemistry was a dreary, repetitive account of the preparation and properties of a few elements and compounds which were rarely selected for study for their common use (17:340). However, the trend from 1936 to 1950 was to stress the study of science topics that related to and represented the biological as well as the physical sciences.

The flurry of dialogue and activity associated with secondary science education in the United States in the 1960's appeared on the surface to have as its prime purpose the creation of a scientifically literate public. Teacher training in content specialities such as space science and the development of national secondary science curriculum projects were specific activities apparently directed toward this end. Critics, however, have identified the results of this effort during the 1960's as more suitable for the fulfillment of the nation's professional needs. They perceived the curriculum projects of the 1960's as intending to improve the education of the college bound (11:351; 29:13) and increase our scientific and technical manpower (14:99). Such perceptions were not surprising. Between 1959 and 1969, the National Science Foundation, in supporting many of the 1960 course content and curriculum reforms, had as an expressed purpose the training of future scientists. By 1970, however, the National Science Foundation had shifted emphasis toward public understanding of science with attention being directed to a greater extent to the non-science major (23:49).

New directions for educational reform during the 1960's in the Soviet Union were introduced in 1956 by Khrushchev's now famous speech downgrading the personality cult built up around Stalin. The mid 1950's marked the beginning of the "most sweeping and liberal school reform in the Soviet Union since the 1920's" (32:33). A major criticism of Soviet education in the 1960's was the schools' academic nature and the divorce of schools from life. Eight year universal education was proposed as a goal in 1958. In the 1966 Five Year Plan, this policy was expanded to include ten years of compulsory education. This goal has been reached in the metropolitan areas, and it is planned for the entire nation by 1975 (15:18). Revision of Soviet text materials in 1968 was accomplished by teams of academicians, scientists, secondary school teachers, and experts in teaching methods (1:496).

Many of the past goals of British science education are similar to those of American education. However, intense specialization is one characteristic which has set British education apart from its American and European counterparts (31:1214). In addition to the relatively high intensity of specialization, British science education was characterized by early specialization with students being homogeneously grouped (31:1215). The 1936-1950 emphasis on general science waned by the 1960's and schools had for the most part returned to teaching science as separate disciplines.

In 1962, the Nuffield Foundation provided massive support for the modification of science education in Britain (27:277). Past science curriculum improvement had been concerned primarily with course content, whereas the emphasis characterized by the Nuffield Projects is the teaching of science as a process of inquiry. This shift in emphasis required a change in teaching methods, laboratory practice, and attitude on the part of teachers.

Personalizing and Integrating Secondary School Science as High Priority Goals

Personalizing and integrating science education can be defined in various ways. Definitions are included here to further establish the context within which the remaining parts of this paper were developed.

"Personalizing" science as defined by this writer means to place greater importance on the personal needs of students. It means providing mechanisms by which individual learners' attributes and desires have considerable input into determining the nature of their experiences. Such factors as motivation, intent, purpose, initiative, belonging, caring, anxiety, and identity are considered as being associated with personalizing science education (8:5).

Selected Literature

As a result of reform in the 1960's, science came to be recognized by its intuitiveness, uncertitude, questions and doubts, its motivations, its dependency on human qualities, its process of inquiry, its underlying principles and non-authoritarian stance (14:95). Science so defined is not necessarily the type of activity that takes place only in physics, chemistry, or biology classrooms. This broadened definition implies the potential for science education to imbue in people a spirit of science with its concomitant manifestation in a wide range of relevant contexts (18:158).

The National Education Association's Educational Policies Commission further clarified and broadened the definition of science by identifying a value system perceived as inherent in the scientific enterprise and which may well be used as a link between the sciences and humanities. It is important to note that the document, Education and the Spirit of Science, advocated "not the production of more physicists, biologists, or mathematicians, but the development of a person whose approach to life as a whole is that of a person who thinks, a rational person" (21:16).

Martin identified and defined the acquisition of knowledge, skills, understanding, and propensities, as four aspects of the goals of science education (18:133). Analysis of these four aspects led him to consider it necessary to broaden the traditional concept of science education. The broader concept of science education is primarily the result of the nature of the propensities of science. Martin defined propensities as tendencies to behave in certain ways, perhaps using knowledge, skills, and understandings. He argued that "science educators should aim not only at having students acquire knowledge, skills, and understanding, but also at having students acquire the propensity to use such knowledge, skills, and understanding in their lives." Consistent with a broader concept of science education, Martin further suggested that instruction in science can no longer be considered an activity restricted to the science classroom but should be harmonized with social and moral questions common to civics, social studies, and other traditional courses.

> Whatever the details of the integration of moral and scientific education, one thing is clear: the ways of science and the ways of morality are intimately connected. The intellectual virtues characteristic of science--honesty, objectivity, impartiality, and rationality--are moral virtues. Science education broadly conceived ought to foster these virtues in both scientific and moral contexts. Let us venture to hope that in the future the ways of science will become meaningful to students and become their ways (18:160).

In 1971, the United Nations Educational, Scientific, and Cultural Organization published New Trends in Integrated Science Teaching in response to the desire in many countries to integrate the teaching of science. Prior publications in this series dealt with physics, chemistry, biology, and mathematics education. The new type of publication was thought desirable as the UNESCO second generation projects were integrated, and there was "an increasing interest at senior-secondary and higher education levels to introduce students to courses in which science was treated as a unified whole, or in which two or more sciences were treated together in a single course" (30:Preface). The UNESCO publication dealt with but one aspect in integrating science as defined by this writer. However, it seems clear that, from UNESCO's international vantage point, there exists a growing interest in looking at science outside of the traditional "subjects" context.

Rutherford and Gardner (26:48) base the reorganization of science into integrated areas on the assumptions that:

> . . . the universe has an inherent unity, and that science as an attempt to provide an understanding

> of the natural world has a unity of purpose, content, and process that is far more significant than the differences in language or focus between individual sciences.

and that:

> . . . the teaching of any subject should in some way reflect the nature of the subject itself. If the natural sciences are becoming integrated in their intellectual structure and are already unified methodologically, then, according to this assumption, science teaching should emphasize this by itself being integrated.

The aforementioned assumptions do not provide rationale for the return to what in the past was called general science. They do provide rationale for establishing alternatives to the classification of knowledge into the commonly accepted disciplines.

The National Science Foundation in stating its aims for the 1970's, recommended a shift in focus "from the traditional discipline orientation to interdisciplinary approaches centered upon problems faced by informed citizens" (23:iii). Revisions of teacher education suggested by the National Science Foundation included a stress on understanding the instructional methods associated with the new curriculum, science content background, and perhaps most important of all, the process of working with varying student audiences.

Considering the problems involved in the Soviet teacher training process, Panachin (24:8) stated:

> Curricula and syllabuses must be divested of such major shortcomings as an excess of subject matter leading to a superficial study of certain scientific disciplines, the lack of coordination between individual subjects, and hence the existence of duplication, and the inadequate orientation toward practical and laboratory work of students and their future pedagogical work in the modern general education, labor, and polytechnic schools.

In a report on why Soviet children fail in school and the shortcomings of teacher activities, Babansky (5:91) presented what he considered the most backward aspects of Soviet teaching. Included in the list of teacher shortcomings was a "deficiency in their individual approach to pupils" and in "the maintenance of ties between subjects."

It is inferred that personalizing and integrating the sciences could in part be an answer to the aforementioned criticisms and that the criticisms reflect concern for the nature of the individual and the nature of science as they are related to each other.

Teachers' needs in mathematics and science initiated the establishment of Teachers' Centers in Britain. These centers are in part a resource center where teachers can analyze existing curricula and develop their own curriculum ideas.

The Sussex Area Teaching Organization, composed of seven institutions cooperating to provide breadth for teaching in-service, described its program as having four components, one of which is an analysis of interdisciplinary studies. In addition, the intent of the program is to

> . . . refine the student's appreciation of the process by which science develops and to alert him to the inaccuracies of conventional expression of the scientific method as being one free from social and political influence and from personal and emotional responses (12:37).

In the Sussex Area Teaching Organization, the Nuffield Project curriculum materials are used as a focus for study with an emphasis on how students relate to science.

Organized courses at another Teachers' Center in Plymouth, England, have been directed primarily at examining ways in which the activities in the guides to science and mathematics curricula can be integrated with other areas of the curriculum. The School's Council Five to Thirteen Project is one science curriculum being used in this integration process.[1]

Among the young in the United States, there is an increasing concern with societal problems, yet there is a sharply declining interest in science (22:25). Decreased science enrollments provide evidence of a steady movement away from science in the United States as well as in other countries (8:4).

Data collected by the Dainton Committee in the mid 1960's indicated a decreasing proportion of students in the British secondary school "science stream." Of the total number of students, the proportion had dropped from 42 percent of the total in 1962 to 31 percent in 1967. This trend was predicted to continue into the early 1970's unless "reforms in the lower echelons of British education make science more attractive" (31:1214).

The faculty at Rolle College in Exmouth, England, expressed a similar concern dealing with their incoming students' perception of science and its place in the curriculum. Apparently, science is perceived by many prospective teachers as an organized body of knowledge memorized for an examination. Science was considered as lacking relevance to living, largely an unacceptable activity for their future students. Considerable effort was being expended by the faculty at

---

[1] Personal notes, Plymouth Teacher Education Center, May, 1974.

Rolle College to redefine science to make it compatible with human endeavors.[2]

Kerr (17:377), recognizing that future changes in British science education would be more difficult than the past modifications of course content, believes that science teachers today agree that the emphasis should be on science as a process, or way of behaving, rather than on science as an organized body of knowledge to be learned.

Bybee (8:4), emphasizing the importance of the American science teacher's personal interaction with students in the process of instruction, cited Tanner's recommendation for "(a) more breadth and humanity in the science curriculum, (b) a unification reducing the gap between the humanities and the sciences, and (c) analyses and clarification, by students, of factors such as values, attitudes, beliefs, and motivations as these bear upon individual choice concerning science" as a means to stem the movement away from science.

At the 1970 International Congress of Physics Teachers Kapitza (16:432), a member of the USSR Academy of Sciences, stated in his address to the Congress that:

> Until now, the main task of secondary education has been the acquisition by every individual of a determined quantity of information in various fields of learning necessary for him to become a worthy citizen of his country. But in the education of creative capacities, an individual approach is needed which considerably complicates education.

Kapitza (16:433) further suggested that, in addition to considering the individual, we should avoid putting any pressure on the natural inclinations of the student, and that the removal of gifted science students to special schools may have a bad effect on the quality of the instruction in the school from which they were removed.

A decree from the Central Committee of the Communist Party of the Soviet Union called for improving the preparation of teachers who work in the Young Pioneer Organization. Although extracurricular in nature, the Young Pioneer Organization draws heavily on teachers for instructional leadership. The decree for improved teacher preparation was considered a means to further the goal of "improving content forms and methods of working with children, of giving more complete consideration to the psychological features of school aged children and their needs and interests" (24:7).

An outlet for independent initiative, individual aptitude and ingenuity in the Soviet Union is provided by circles or clubs which supplement the formal curriculum. Excellent leadership is provided the various Science Circles through use of faculty from Soviet universities. Practicing scientists often direct student projects.

---

[2] Personal notes, Rolle College, 1974.

There is no streaming or tracking on the basis of ability in the Soviet public schools, but special schools do exist for students who show high scientific aptitude. Students compete at around age fifteen in local, regional, and national examinations to gain entrance to these special schools for the sciences.[3] The special science and mathematics schools, begun in 1962, were still considered experimental (20:62). With the advent of the proposed ten years of compulsory education in the Soviet Union, a general component is to be continued on into the specialized schools.

Babansky (5:4) noted the decrease in the percentage of Soviet students being left back to repeat a grade from 13 percent in the 1930's to 2.8 percent in 1969-1970. Promotion is automatic except at the eighth and tenth year. Approximately 97 percent are promoted from one grade to another. Babansky recommended a differentiated approach toward failing students, 70 percent of which are boys. Contrasted with a fourth grade examination to determine a child's tenure in school during Stalin's time, the decrease in grade repeaters might be considered a liberal trend.

Emerging Curricula

Tanner (28:355), summarizing the characteristics of future curriculum reform, considered (1) greater student involvement and participation, (2) the integration of knowledge and its relevance to the real world, (3) the environment and quality of life, and (4) the clarification of values and social policies as focusing on the real and pressing dilemmas of human beings.

A survey of secondary science curriculum materials supported by national agencies revealed a number of projects that possess characteristics which reflect Tanner's predicted focus for future curriculum reform. Strategies and materials are being explored and developed in the United States which allow for personal alternatives and include a broader base of experience and learning. For example, the initial areas of study being developed in the Science, Technology and Society Project include:

1. Aging and Death
2. Genetic Engineering and Society
3. Technology Work and Leisure
4. Science, Technology, War, and the Arms Race
5. Science, Technology, and Privacy
6. Science, Technology, Math, and the Arts.

The topics were chosen because "they raised complex, controversial issues of high interest to students" (2:4).

---

[3] Personal notes, Lenningrad, May, 1974.

The structure of the Intermediate Science Curriculum Study (ISCS), a curriculum though designed for the contemporary school schedule, allows for greater diversity in that the rate, scope, and sequence of instruction are varied. In this action-oriented, hands-on environment, students can manage their own time, choose from alternatives, work in small groups or as individuals, experience greater peer and pupil-teacher interaction and appear to have a more positive attitude about their teacher and classroom than do students in other types of classroom environments (19). It is estimated that 25 to 45 percent of all junior high school age science students are involved at some level of ISCS, making it the most widely accepted of the National Science Foundation supported projects.[4]

The development of the Individualized Science Instructional System (ISIS) materials is directed toward producing an alternative to group instruction in a single discipline. Its goal is to develop a structure that "centers upon individualized instruction, strikes a careful balance between theoretical and applied science, places considerable emphasis on social implications, and emphasizes measurable objectives without losing sight of the affective dimensions of learning" (7:Foreword). This project appears to include a concern for how science makes a student feel. The strategy is to create approximately 81 three-week blocks of instruction, each one a self-paced minicourse. Topics are interdisciplinary and chosen for their interest and relevance to students. The potential for student choice of varied combinations and sequences of these modules and the self-paced format should provide the secondary science teacher with the opportunity to alter the classroom atmosphere considerably.

One of the more penetrating attempts to personalize education and broaden the content base of the science curriculum is represented by the Environmental Studies (ES) materials. Students are presented numerous alternative choices in such a fashion that both the specific content and the means by which it is acquired are determined by the student. Tasks are purposely kept ambiguous so as to require greater decision making by the student. An example would be, "Go outside and find a million of something and prove it." The purpose is to tap aspects of the human mind not generally challenged within other curriculum designs. Use of the subjective, intuitive, creative, relatively quiet part of the mind as well as the use of the logical, analytical, more conscious part is encouraged. Essentiasheet No. 1 (10), presenting the Environmental Studies point of view, described the Environmental Studies materials as increasing in students the probability of:

1. developing maturity in decision making.
2. gaining a more positive attitude toward learning.
3. exploring a wider base of content.
4. developing a more complete and realistic image of self and others.

---

[4] Personal notes, National Science Foundation Directors' Meeting, Atlanta, Georgia, February, 1975.

The Environmental Studies materials allow both the acquisition of content and the development of qualities of humanness that have been too long ignored in educational strategies.

The Human Sciences Program, a new multidisciplinary curriculum for middle school grades six through eight proposes a new theoretical base as a means of seeking an alternative to subject matter organization. A series of generic questions reflecting student questions and concerns are the nucleus around which non-sequential modules are developed. Why do things change?, Why do living things act as they do?, What determines who gets what?, and What is normal?, are examples of generic questions which seem to subsume the great majority of student questions and concerns. The Human Sciences Program is "not designed to update the content of selected sciences, nor to increase the efficiency of learning the subject matter of a particular science" (22:14). Concepts are drawn primarily from the biological, social, and behavioral sciences.

A minicourse approach to curriculum organization is the means by which the Technology-People-Environment Curriculum intends to accomodate students having less ability or motivation and perhaps erratic attendence patterns. Most of the initial minicourses can be carried out in one class period. A modified version of The Man-Made World, the Technology-People-Environment materials are interdisciplinary and stress the interaction between man and machine and between society and technology (22:14).

The ways and means of adding the personal dimension is a concern in British as well as in American science education. The April 1974 issue of Education in Science contained a call from the General Secretary of the Association for Science Education for information on the techniques and problems involved with science teaching with heterogeneous classes and open laboratories for all learning levels (9:15).

British secondary science instructional schemes generally have paid attention to the subject and very little to the student. The original physics, chemistry, and biology Nuffield Science Courses initiated in 1962 for eleven to sixteen year olds are described primarily by their emphasis on science as inquiry, not the inclusion of a mechanism for personalizing or integrating science. The second generation curriculum materials, however, reveal an emphasis on defining the interests, needs, and capacities of the student as well as the integration of science content and process. The main aim of the Patterns Two, School Council Integrated Science Project is to (1) educate in social responsibility, (2) consider physical, biological, earth, and social sciences, (3) include the aesthetic, moral and economic aspects of sciences, and (4) reduce the pressure for specialization (4:7).

It is not my purpose to consider the changes taking place in the British Infant (five to nine years) and Junior Schools (nine to thirteen years); however, the philosophy of open education at these levels may have direct influences on the mission of secondary science education. In an attempt to create learning situations in science compatible with the nature of children, curriculum materials are being developed and implemented using the intellectual-developmental stages of the student rather than on the basis of subjects or chronological age. These stages cut across existing boundaries of the Infant, Junior, and Secondary School, and may influence the objectives of science at the secondary level.

The specific nature of the emerging secondary science curricula in the Soviet Union is difficult to discern. Alexandrov (1:495), reporting at the International Conference on Public Education, indicated plans for the adoption of new curriculum materials in the early 1970's which included more time for independent experiments, excursions, and practical work for Soviet students. It is interesting to note that in the past all school subjects were compulsory; however, optional classes are currently being offered for senior students.[5] In addition, in 1971, the USSR Council of Ministers placed an official limit on the amount of homework teachers may assign (15:20).

The writer has sought to provide studies to illustrate that integrating and personalizing science are goals at the secondary level in Great Britain, Russia, and the United States. Although the intensity of the priority assigned may vary within different nations, it is proposed that in the advanced technological societies of the United States, the Soviet Union, and Britain, there is increased attention and concern directed at how to better relate science to the human condition. The intent was to substantiate as a recognized goal the desire to create science education which is consistent with the nature of young people and at the same time, consistent with the nature of science.

A Point of View

When the structure of the secondary science education curriculum is viewed through the eyes of someone who believes in the overriding American goal of universal education, secondary science education often does not fare too well. Science education in the public schools should be designed for the general public, as well as for those who may wish science careers or are in the upper 25 percent of their class. All too often the learning process seems more likely to be designed to weed out those students who cannot make the grade. Those who do not match up are shuttled off to humdrum descriptive courses where they can meet the state requirement. From the student's vantage point, making the grade means learning a specific quantity of material in unison with classmates by a certain date. Various devices, external to students, are used to motivate them toward this end.

Student interest in science is kept to a minimum by the commonly used tracking system. The sequencing of specific courses and the use of prerequisites prevent a large segment of the high school population from experiencing many aspects of science. Earth science, biology, chemistry, and physics courses sequenced for the ninth, tenth, eleventh, and twelfth grades separate those who are from those who are not science minded and may prevent the discovery of a hidden reservoir of interest and talent. More important, it may prevent individual students from perceiving the relationship of science to their own lives.

---

[5] Personal notes, Lenningrad, May, 1974.

American educators generally do not support the practices described in the two previous paragraphs. Teachers express a desire to let students work at their own rate, have remedial assistance, seek out and pursue their own interests, proceed to more sophisticated concepts, get turned on, and express their opinions and feelings in an atmosphere free of fear. Andersen and Koutnik (3:7) refer to this divergent use of science skills as a form of self-actualization.

In addition, most educators would agree in principle that they are concerned with the reasons students have for being in school, how they value themselves, what goals they have, and how they are perceived by other students. There is a desire to get to know the student as a person. However, the junior and senior high school science teacher with his 100-150 pupils, two to three subject preparations, and outside assignments may well be willing but not able to achieve this personal dimension within the constraints. If, in addition, the teacher is harnessed with inflexible materials (few alternative routes for students to pursue) then the task of personalizing and integrating science becomes impossible.

There is a need to search for ways of creating different instructional environments which lie outside the current concept of thirty students in a room, in a course, and in (or out of) a track or curriculum. The medium within which science is experienced by the student is of great importance. Is it possible to experience the non-authoritarian stance of science as a human intellectual activity in an environment where conformity is the rule and the teacher and text are the ultimate source of all knowledge? Is is possible that within the formal, academic domains of our subjects and disciplines there is little room for students to perceive the big picture? Is the subject classification scheme we have created placing restrictions on how we think, organize our thoughts, and how we perceive and solve problems? Are the solutions to man's dilemmas to be found within the traditional framework of science education? The search for answers to the above questions will continue to influence the selection of high priority goals for science education.

As always, the classroom teacher's level of awareness, acceptance, and skill at implementing either traditional or new curricula is a key factor in determining the nature of science education. There are, however, two additional factors that come to the forefront when attempts are made to personalize science education. First, students accustomed to being dependent are somewhat confused and disoriented for a period of time. Since they have had little opportunity to develop self-management skills in past situations, many require a period of orientation and adjustment. For some, an inordinate dependency relationship is so well developed that they may never succeed in making a transition. Alternatives compatible with the student are required.

Second, the science curriculum should be viewed as a means, not an end. Of what value is education which conforms precisely to a prescribed model but which alienates, confounds, and drives away those for whom it was intended? Positive, honest, and warm personal interactions between teachers and students is considered here as being important as a goal of science education.

It is proposed that our role as science educators should be to assist the young to a point where they no longer need us as a crutch. In essence, it is a continual striving on the part of the classroom science teachers to put themselves out of business--at least, much of the kind of business typically associated with many past and current practices in science education.

Summary

It has been proposed that an increasingly high priority is being given to integrating and personalizing science education and that this emphasis should further influence the nature of secondary school science.

Citations from the literature were presented which identified dissatisfactions with current practices and pointed out directions we might pursue. In addition, emerging curricula models were summarized and offered as an indication of the elevated priority given to integrating and personalizing science education. A trend for students to reject the sciences while expressing increased concern for social and environmental problems is viewed as an anomaly resulting from a lack of perception as how science as a human endeavor relates to the condition of man.

If the mission of science education is indeed shifting toward that of developing personal alternatives and interactions within integrated areas of study, we can anticipate increased acceptance of them as prime reference points when making value judgments as to what is "good" science education for twelve to eighteen year olds.

REFERENCES

1. Alexandrov, Nicolai. "Educational Developments in 1967-68." USSR International Yearbook on Education, 1968.

2. American Association for the Advancement of Science. Science Education News. Washington, D.C.: AAAS, December, 1972.

3. Andersen, Hans O., and Paul G. Koutnik. Toward More Effective Science in the Secondary School. New York: The Macmillan Company, 1972.

4. Association for Science Education. Advertisement for Patterns Two, Education in Science, 57:7, April, 1974.

5. Babansky, I. K. "Optimization of the Teaching Process," *Soviet Education*, 15:3-93, October, 1973.

6. Bereday, George Z. F., *et al*. *The Changing Soviet School, The Comparative Education Society Field Study in the USSR*. Boston: Houghton Mifflin Company, 1960.

7. Burkman, Ernest. *Gut Reactions*, Experimental Edition. Tallahassee: The Florida State University, Fall, 1974.

8. Bybee, Roger W. *Personalizing Science Teaching*. Washington, D.C.: National Science Teachers Association, 1974.

9. Dyball, R. H. "From the General Secretary," *Education in Science*, 57:15, April, 1974.

10. Evergreen State College. *Essentiasheet No. 1*. Olympia, Washington: The Evergreen State College, Undated.

11. Foshay, Arthur W. "How Fare the Disciplines," *Kappan*, 7:349-352, March, 1970.

12. Grassie, A. D. C. "Science as a Component of the Sussex B. Ed. Degree for Serving Teachers," *Education in Science*, 57:36-38, April, 1974.

13. Holmes, Larry E. "Bolshevik Utilitarianism and Educational Experimentalism: Party Attitudes and Soviet Educational Practice, 1917-1931," *History of Education Quarterly*, 13: 347-360, Winter, 1973.

14. Hurd, Paul DeHart. *New Trends in Teaching Secondary School Science*. Chicago: Rand McNally and Company, 1969.

15. Jacoby, Susan. "Soviet Schooling: A Quiet Revolution," *Saturday Review*, 54:17-20, July, 1971.

16. Kapitza, P. "Science Teaching and Scientific Method," *The Physics Teacher*, 9:429-434, November, 1971.

17. Kerr, John F. "Science Teaching and Social Change," *New Trends in Integrated Science Teaching*, 7:337-345, 1971.

18. Martin, Michael. *Concepts of Science Education: A Philosophical Analysis*. Glenville, Illinois: Scott, Foresman and Company, 1972.

19. Mills, Terence J. Unpublished Survey of 4,000 Junior High School Pupils, Oklahoma State University, 1974.

20. Moos, Elizabeth. *Soviet Education, Achievment and Goals*. New York: National Council of American-Soviet Friendship, 1967.

21. National Education Association. *Education and the Spirit of Science*. Washington, D.C.: NEA, 1966.

22. National Science Foundation. *Course and Curriculum Improvement Projects*. Washington, D.C.: U. S. Government Printing Office, 1974.

23. National Science Foundation. *Science Education--The Task Ahead for the National Science Foundation*, Report of the Advisory Committee for Science Education, NSF 71-13. Washington, D.C.: U. S. Government Printing Office, 1970.

24. Panachin, F. G. "Urgent Problems in Teacher Training in the Ninth Five Year Plan," *Soviet Education*, 15:5-24, July, 1973.

25. Richardson, John S. *Science Teaching in Secondary Schools*. New Jersey: Prentice Hall, Inc., 1957.

26. Rutherford, James and Marjorie Gardner. "Integrated Science Teaching," *New Trends in Integrated Science Teaching*, 1: 47-55, 1971.

27. Spice, John E. *The Nuffield Physical Science Course*. Paris: UNESCO, 1971

28. Tanner, Thomas R. "The Science Curriculum: Unfinished Business for an Unfinished Country," *Phi Delta Kappan*, 7:353-356, March, 1970.

29. Trowbridge, Leslie W. "Trends and Innovations in Junior High School Science in the United States," *The Science Teacher*, 4:12-15, April, 1974.

30. UNESCO. *New Trends in Integrated Science Teaching*. Paris: UNESCO, 1971.

31. Walsh, John. "Dainton Report: British Youth Swings Away From Science," *Science*, 159:15:1214-1215, March, 1968.

32. Zepper, John T. "Recent and Contemporary Soviet Educational Thought," *School and Society*, 50:31-33, January, 1972.

THE MISSION OF SCIENCE EDUCATION

THE SECONDARY SCHOOL

Ronald D. Simpson
North Carolina State University
Raleigh, North Carolina 27607

A Reaction

One of the editors of this yearbook once heard me say that one of my hobbies is philosophy. I realize my mistake now. Grappling with a question like What is the mission of science education? is not my idea of how to spend leisure time. When I was first asked to react to this paper the tentative title established was "The Mission of Secondary School Science." Even though the title has been altered, I still view the implied thrust of this paper as dealing with missions, objectives and priorities in science education with particular emphasis on secondary schools.

In fact, this topic is so vast with so many ramifications that it is difficult to know where to start. My charge at this time, however, is to react to Professor Mills's presentation, The Mission of Science Education. His article is well written and contains thorough documentation. I find that I agree with most of his ideas. His emphasis on personalizing and integrating secondary school science certainly represents mainstream thinking among teacher educators today. I was particularly enamored with his statements under A Point of View:

> Science education in the public schools should be designed for the general public, as well as for those who may wish science careers, have aptitudes for, or are in the upper 25 percent of their class. All too often the learning process seems more likely to be designed to weed out those students who cannot make the grade. Those who do not match up are shuttled off to humdrum descriptive courses where they can meet the state requirement. From the student's vantage point, making the grade means learning a specific quantity of material in unison with classmates by a certain date. Various devices, external to students, are used to motivate them toward this end (p. 36).

This represents the real world, at least the one I visit when I leave my college classroom and visit most secondary schools.

But a reaction paper is always more interesting if there is at least some divergence in approach. I see little to disagree with based on what the author of this paper has said. Where I can offer some divergence is that what Professor Mills did not say. To begin with, the term mission intrigues me. In our language the term mission implies a sending forth, a commissioning of individuals for performance. Mission as a noun represents a message and as a verb denotes the carrying out of this message. In attempting to collect my thoughts on what is the mission of secondary school science, I could not help but ask peripheral questions like, What is the mission of mathematics?, Does *physical education have a mission? Does science as an enterprise actually* have a mission? When placed in the secondary schools does science, then, take on a mission?

I have always considered J. Bronowski's (1) definition of science to be my favorite. He has stated that science is man's attempt to command more of nature's hidden potential. In my own conceptual framework (one luxury you are afforded when writing reaction papers), I see the term mission fitting people rather than academic topics or processes. In fact, when I ask myself "What is the mission of the human being in this world?" I come up with two goals that seem to subsume all others. Everything we do as members of this living system points toward survival. Given survival, we strive towards fulfillment, the additon of meaning and contentment in our lives.

It is we, intelligent living creatures, who generate the concept of mission. It is at the individual level where missions are potentially derived. It is through groups that we formalize our missions and publicly establish, state and enforce our priorities. I submit, then, that it is not science that possesses a mission, rather, it is people who do. I would suggest that we might want to ask ourselves the question, What are the goals, the missions, of the students for whom we administer programs in the secondary schools of this country today?, What are the goals of our society? More specifically, as educators perhaps we should be asking ourselves additional questions such as What can our schools do to help increase the probability of survival? and What can our schools do to help add meaning and human fulfillment to the lives of its citizenry?

Obviously you have detected by now that my orientation differs from Professor Mills's primarily by way of semantics. In fact, his two major themes, personalizing science and integrating science, serve to move the focus point *from* science, the discipline, *to* students, humans with missions. While I do not see science as having a mission, I do see educational programs as inherently possessing missions. In fact, our present-day concept of the term "education" presupposes that there are at least *some* objectives, whether hidden or stated publicly. As professional educators we are primarily involved with designing experiences that will lead to residual changes in behavior. We are, in part, behavioral engineers. To some this appears crass, but this is what education has always done. Only recently have we publicly admitted this and been willing to be accountable for it. In classrooms, teachers are primarily change agents, directing activities designed to modify behavior. In science classrooms these behaviors specifically relate to the principles and processes of science.

If science education has a mission then it must of necessity fall within the paradigm I have described; students, young humans searching for survival mechanisms and new values, being acted upon by competent educators equipped to delineate direction, suggest learning strategies, and assess outcomes. In other words, students represent a potential direct force while teachers, on the other hand, represent a potential indirect force. Interaction between these two forces represents a potential medium through which students can accomplish their personal goals and educators can shape, reinforce and alter directions commensurate with societal values. In essence, science education at the secondary level involves bringing together 1) adolescents, 2) teachers, and 3) the enterprise of science into a triad that potentially deals with those aspects of our lives relating directly or indirectly to science. When we deal with science in the secondary school we are speaking of a unique, specific combination of variables not found elsewhere in quite the same blend. The mission of this system, nevertheless, will always reflect the goals, desires and needs of the people within the system. This is particularly significant in a democratic society.

It appears that science educators involved with designing curricula for high school students or preparing classroom teachers for the future need to focus on the interaction of students, teachers and science depicted in my schematization in Figure 1, representing the secondary school setting. We need to know more about students. We need to know what is on their minds and where they are directing both their affective and cognitive efforts. I am afraid that often the objectives of many of our science programs do not correspond in the least to the interests and goals of our learners. This is particularly true of the huge segment of high school students who do not appear to be involved with or stimulated by their science courses. Abstractions held so closely by scholars often are meaningless to immature learners.

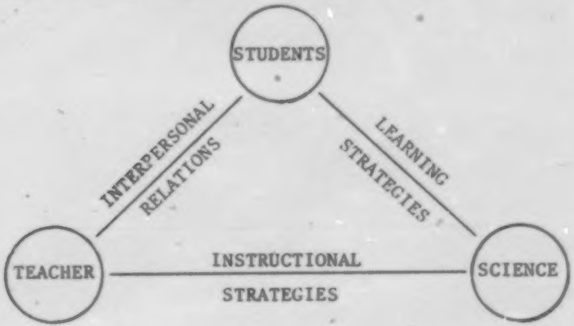


Figure 1

We need to know more about teachers and common ingredients of effective teaching. Hopefully, as we continue to study the concept of competency-based teacher education we will continue to search for at least minimum teaching skills that lead to positive student outcomes. In science teachers we should attempt to develop excessive amounts of openmindedness, inquisitiveness, and intellectual flexibility. As teacher educators we should not only be concerned with technical proficiencies of our products (preservice and inservice teachers) but also their cognitive, ethical and affective qualities.

The third member of our triad is science. Science has long been characterized as being comprised of content and process components which intertwine to synthesize new knowledge and provide us with new intellectual tools. But science as a human enterprise is so often misunderstood, even by those closest to it and by those who purport to interpret it. New studies by Kuhn (2) have proposed that science does not work the way most of us have thought. Rather than scientists exploring each question with bold, fresh objectivity, researchers appear to interpret new findings within the framework of existing, popular models or paradigms. These paradigms necessarily are influenced by other human creations such as language, philosophy, mathematics and, of course, human judgments and values. Scientific endeavor is filled with limitations. And the limitations should be taught along with the victories of science. Furthermore, science should be viewed as a means to an end, a vehicle potentially capable of taking us from point A to point B. We must inevitably call upon the poets, playwrights, humanists, theologians and comics to help us realize whether reaching point B is consistent with our cultural heritage, human needs and societal values. It is the philosophers, people on the street, and our children who need to answer "Is this really good?" and "Is this really where we want to go?"

Students, teachers and science produce many complex interactions. There is little question that the real curriculum is that which happens after the classroom door is closed and the teacher and students begin responding to each other. There is little doubt that programmed materials, teaching machines and computers cannot begin to match the potential catalytic effect of a competent Homo sapiens teacher on the enthusiasm and motivation of learners. We all know that the mark of superb teachers is their ability to inspire students. Interpersonal skills should be prerequisite to all other skills in teacher preparation programs. Before we allow any human to be placed in a position to work with the minds of young people we should have some assurance that he has mastered basic interpersonal skills.

Another interaction within my schema is teacher with science. Here the teacher serves a facilitative role. A teacher not only engineers instructional strategies based on appropriate educational objectives but represents an embodiment of the subject he or she teaches. Interests, preferences, attitudes and ultimate values are formatively and summatively addressed. Concerning instructional strategies, we have not yet begun to understand the mechanisms involved when we interface a given type of student with a given type of conceptual material. We still know little about the nature of the uninvolved student and how their needs and perceptions link with current curricula in science.

One of the reasons given for the success of science in our modern world is the universality of its language. Scientists, as mentioned earlier, operate for relatively long periods of time under single paradigms. In fact, when new paradigms emerge they constitute a revolution or "scientific breakthrough." Professional education has not yet adopted a paradigm that is clear and useful to the majority of its people. Conversely, with intense frequency professional educators adopt new sub-models or pseudo-paradigms, each with a half-life of only a few years. We have moved from programmed instruction to open classrooms to personalized instruction to performance-based learning with such haste that we meet each other coming and going. We push general science, then "hard-core" science, then unified science, then multidisciplinary science.

Professor Mills has emphasized integrating and personalizing science as representing the mission of secondary school science. My reaction is that science educators should be primarily concerned with learning more about the complex interactions that occur when secondary students, teachers and science are brought together. While I do not disagree with Professor Mills's dialogue, I prefer to take the position that the dynamic, collective needs of our society and the deep-seated, individual needs of our students reduce to a moot point the question of what mission science or science education should adopt as its theme for 1976. My biases, rather, lie in the direction of suggesting that science educators work toward developing a model or paradigm that has survival value; a vehicle rather than a prescription that allows us to explain our endeavors within whatever current social or political parameters we must operate in at a given time. It seems to me that our role is not to design the mission but to understand the nature of our existence. Humans possess missions, not science. If secondary school science educators have a mission, it seems to me it would be to study more carefully the matrix of adolescent students, science teachers and the enterprise of science and how they shall be brought together in the future.

REFERENCES

1. Bronowski, J. Science and Human Values. New York: Harper and Brothers Publishers, 1956.

2. Kuhn, Thomas S. The Structure of Scientific Revolutions, Second Edition. Chicago: University of Chicago Press, 1970.

PART II

THE PEOPLE OF SCIENCE TEACHING

THE IMPLICATIONS OF PIAGETIAN THEORY FOR SCIENCE EDUCATION:

A POSITION PAPER

Nancy R. Torop
Rosemont College
Rosemont, Pennsylvania 19010

and

William Torop
West Chester State College
West Chester, Pennsylvania 19380

Introduction

Statements of theory and theory building are crucial elements for the growth of any scientific discipline. It seems clear to us that science education must draw on a variety of theoretical perspectives to further develop as a discipline. These perspectives should provide guidelines for research and a framework for building classroom methodology. There are many theoretical perspectives within philosophy, value theory, and sociology which can be useful for approaching problems in science education. Closely aligned with education, both historically and logically, is psychology. Within the field of psychology there are a variety of schools of thought which have been applied to education in general and sometimes to science education in particular. These alternative schools include, but are not limited to, behaviorism, humanistic psychology, and cognitive-developmental psychology.

Of these approaches the cognitive-developmental, specifically the work of Jean Piaget, has been one of the most popular in science education. This popularity raises a number of questions: Is Piaget just a passing fad of the seventies or will his contributions be such that they will have a lasting, positive effect on our educational system? Why is there suddenly, in the last ten or more years, such an intense interest in a man who has been writing, and publishing, for forty years? The American educational system, in recent years, has experimented with accountability, alternative schools, competency/performance-based teacher education, differentiated staffing, educational vouchers, ombudsmen, performance contracting--to name just a few things. In particular there has been a frenzied development of new curricula in science since the launching of Sputnik. "Through the fiscal year of 1969, more than 400 projects at the pre-college and undergraduate levels have been supported by two Education Divisons of NSF at a cost of approximately 142 million dollars" (10:209).

In the rush to develop and implement these new science curricula, there has been a tendency to concentrate on the methods and the content and to pay little attention to what should be the central focus of these changes: the child. "The intent of the innovative educator should be to prepare the child to cope with an ever changing world of knowledge" (36:1). Does Piaget have something to offer American educators in these areas of curriculum and/or understanding the child? Is much of what is being done in our schools as "Piagetian" a misinterpretation of Piaget as a result of hopping on a current bandwagon or of the American dream of an instant solution? Is it possible to have a direct translation of Piagetian (or any psychological) theory into a classroom setting? These are the kinds of questions raised by this paper. The reader will find here a framework within which they can be addressed.

Some Psychological Models for Science Education

Although there are many theoretical models from a variety of disciplines which might have fruitful implications for science education, this paper will concern itself with the more narrow view of the contributions of psychological theory. Several psychological models have been used as a basis for the formulation of educational programs. Each model describes human learning somewhat differently so that the educational programs which grow from them also differ.

There are two basic views of the human being as a learning organism. The behaviorist school sees learning primarily as a passive process of responding to external stimuli while the cognitive-developmental and humanistic approaches view learning as an active process. The basic model which one chooses as a valid description of the learning process guides the kind of program one develops to prescribe the instructional sequence.

Skinnerian Behaviorism

It is difficult to know the extent to which science education in this country has been influenced by prevailing American learning theorists using the stimulus-response model. Skinner is perhaps the best known of these in the field of education. Basically the behaviorists do not see any qualitative difference between children's and adult's thinking or learning. They have, through significant experimental work with lower animals, devised a model of learning based on reinforcement of correct responses to designated stimuli. Skinner, in particular, focuses only on observable behavior and shows no concern for internal, mental structures.

Since this view of learning reduces to a mechanical manipulation of behavior by controlling the responses by reinforcement, it appears very useful in the practice of education. "Given the fact that learning so defined consists essentially in the encoding of external features, the reinforcement of known situations, and the forced extraction of knowledge by the child from external situations, one can conceive of uniformity in education" (43:159).

Taken to the extreme the Skinnerian approach could have every child interacting with a teaching machine following a programmed curriculum which requires only that he choose the correct answer to move ahead. This system might conceivably be considered advantageous in that the child should never experience failure, since, according to the model, all behavior can be shaped by reinforcing successive approximations of the desired response until the correct response appears.

The difficulty with this model is that its basic premise is contradicted by all that we know regarding the development of children's thinking. The evidence gathered by the Geneva group (Piaget and colleagues) provides incontestable information about qualitative differences in children's thinking as they progress through the various stages of development. Simply to avoid dealing with mental structures, as Skinner does, because they cannot be observed directly is, in our view, a short sighted view of the complex human organism.

Competency/Performance-Based Program (An Example of Neobehaviorism)

There is a significant movement in this country to develop competency-based instruction at all levels. This approach would specify in behavioral terms exactly what is to be learned in the classroom, the conditions under which this learning is to occur, and an evaluation technique for ascertaining whether or not this learning did, in fact, occur.

To this end curricula are designed with specific behavioral objectives in mind. Since it is far easier to design objectives at lower levels (knowledge, comprehension, application) and far easier to evaluate, through objective tests, the acquisition of facts, a program such as this may emphasize content and not process, subject matter and not the learner, achieving the correct answer and not building cognitive structures. While it may be possible to design competency-based programs which focus on the child, it is equally possible to lose sight of the child in the frenzy to write objectives.

Lest the reader misunderstand, we are not advocating science education with no plan. Certainly teachers must decide what they want to achieve with the children and certainly they must have plans for achieving goals. However, the stringent requirements of specifying behaviors may very well restrict the environment rather than enrich it. One cannot always predict how a child will respond to a situation and it may be that he constructs goals for himself which are different from those of the teacher.

Student - Directed Approach (Humanistic Psychology)

Another avenue is the "Freedom To Learn" approach described by Rogers. The basic thesis is that the teacher is a facilitator of the learning process, rather than an encyclopedia of knowledge who prescribes what is to be learned. The teacher asks himself questions like: "What is it that I must teach? How will I know when I have taught it? What materials and procedures will work best to teach what I wish to teach?" The facilitator asks questions, not of himself but of the students: "What do you want to learn? Where do your interests lie? Can you evaluate your own performance? How will you obtain your goals and objectives?" The facilitator (teacher) then works with the student to help him obtain his goal. One of the basic principles of learning, according to Rogers, is that "self-initiated learning which involves the whole person of the learner--feelings as well as intellect --is the most lasting and pervasive" (32:162).

Furthermore, significant, meaningful, self-initiated learning can be achieved or realized in an elementary school class, as described elsewhere (32:11-27). However, this cannot occur in the traditional conservative, rigid, bureaucratic schools that one usually finds in America. Nor is this the way to learn for every child. Not every child is inner-directed and self-motivating. Implicit in this approach, although admirable perhaps in its goals, is the assumption that children will be able to seek and find all the materials and experiences necessary to promote intellectual growth. Some may; many will not. Taken to an extreme, one might wind up with a society without schooling-- "a society in which learning is not separated from, but joined to, part of life" (13:117).

Currently there is a major thrust in the scientific and engineering industries for continuing education among scientists and engineers. The Carnegie Commission on Higher Education has recommended that programs and opportunities for continuing education be greatly strengthened and augmented. These opportunities need not occur in some place called "a school" with a person called "a teacher." Alternatives to conventional teaching methods include audiotapes, videotapes, television, programmed textbooks, film loops and other such multi-media approaches. However, the place for these materials is in an expanded public library facilty open to all rather than in a school open to a limited number of students.

We have no argument with allowing society its educational functions. Nor do we dispute the value of programs which permit or invite adults to continue learning, in a school or outside of one. However, since we maintain that there is a qualitative difference in the way children and adults learn, we still see the need for specialists in education, i.e., teachers, to use their knowledge in creating environments for learning. These must differ from what has been the traditional classroom, for if we wish to educate all of our children we must create the opportunity for them to be educated.

Position--Piagetian Theory as a Fruitful Approach For Science Education

Our position is that psychological theory can make significant contributions to science education. We further believe that the psychological theory which has the most to offer science education is Piaget's cognitive-development theory. We do not deny that there are positive aspects in each of the alternative models which were briefly discussed above, but we view them as somewhat less fruitful because of their lack of focus on the developing child. Some of the implications of these alternative models are not in direct conflict with a Piagetian approach, particularly if we view the Piagetian model as one which opens new vistas rather than one which sets limits on educational possibilities. We will therefore demonstrate that Piagetian theory can make significant contributions to our thinking about curriculum development, classroom environment, and teacher development.

Rationale

Curriculum revision without consideration for the nature of the developing child is fruitless. The child's ability to profit from experience depends upon his intellectual and emotional status. By intellectual status we do not mean I.Q. but rather the child's developmental level. Piaget and his colleagues in Genevá have constructed a model of the developing child based on many years of detailed observations and experiments (23). They have demonstrated a step-by-step process of intellectual growth as the child constructs and reconstructs his knowledge about the world.

It took a long time for Piaget's contributions to be appreciated. First, his work was in French and it was not until the 1950's that the majority of his early writings were translated into English. Second, his original writings are difficult to follow. This may be the result of Piaget's being a genetic epistemologist who writes like a philosopher with complex terminology. Third, the clinical method used by Piaget and his colleagues is far different from the scientific approach of controlled variables, representative sampling techniques, and statistical treatment of data advocated by those generally doing research in psychology and education. It was only when these researchers began to appreciate the complexity of human behavior and the difficulty of reducing it to simple laws that Piaget became an important figure in the fields of both psychology and education.

The work of Piaget has implications for pre-service and in-service teacher education. Developing a sensitivity to and an understanding of the child's intellectual and emotional status requires a thorough assimilation of Piaget's theory of cognitive development as well as a familiarity with children which comes only from interaction with them. Such an understanding does not come from reading one or two articles or even one or two books about Piaget. Nor does it come from a single course in child development. It can only come from continuous study and experience with children.

The teacher is at least partially responsible for guiding the development of the child's mind. Although a great deal of knowledge exists, we do not know all the answers in either psychology or education. Much as we may be pressed for instant solutions, we have to be able to tolerate delay and tolerate mistakes as we seek the answers to our science education questions. We must develop an attitude of tolerance and willingness to experiment.

Piaget, himself, urges teachers to do his experiments with children in order to see what is behind a child's apparent understanding or lack of it. He further urges teachers to do research themselves.

> It must be emphasized strongly that pedagogy cannot be deduced from psychology directly. Teachers themselves must function as research workers--if they are free to do so. . . But if teachers are free enough, they must develop an experimental pedagogy that is not limited to such small problems as trying to find out if one reading method gives better results than another reading method. They have to look at greater questions--what should be taught, what should not be taught, and so forth. Such an experimental pedagogy would utilize observations and experiments of all the various programs to determine why they were successful in certain cases and failed in others. Teachers who have worked with different materials and approaches, therefore, must learn to confront each other and discuss the advantages and disadvantages of each. All this can only be the work of educators. Knowing about our psychological findings is only one necessary aspect; they must also know about teaching and children (5:26-27).

If we want to be able to understand why things happen in the classroom and to be able to explain what we are doing, with causal interpretations and causal explanations, then we have to look to psychology for some of the answers. Psychology is a broad reaching field, fruitfully exploring the physiological processes which relate to behavior, the perceptual processes relating to the organization of stimulus input, the learning processes and related areas of memory and cognition, as well as the development of all these processes for a fuller understanding of the complexity of human behavior. Piaget and his colleagues, as genetic epistemologists and psychologists, are particularly interested in the development of intelligence and the growth of knowledge--how children come to know the world and the way that they think. Yet we must not assume that research in psychology will supply the answers for science education. It is science educators themselves who must translate the findings of basic reasearch into practice.

Piaget decries the fact that despite our rapid expansion of knowledge in almost all branches of natural, social, and human sciences, with the concomitant development of great men of international reputations, basic research has been meager in the field of education. He states unequivocally that during the past thirty years

> . . . no great pedagogue has appeared whom we can add to the list of eminent men whose names provide our milestones in the history of education. . . The general problem is to understand why the vast army of educators now laboring throughout the entire world with such devotion and, in general,

> with such competence, does not engender an elite of researchers capable of making pedagogy into a discipline, at once scientific and alive, that could take its rightful place among all those other applied disciplines that draw upon both art and science (25:9-10).

Piagetian Theory: A Brief Overview

Questions pertaining to science education inevitably raise problems related to the psychology of development, the psychology of learning, and the psychology of intelligence. Focusing on Piaget, let us observe what Piagetian theory is--and is not. It is important to note that Piaget is a genetic epistemologist and as such is primarily concerned with the nature and acquisition of knowledge. One of the major efforts of the Geneva group has been to investigate the relationship of logical and rational organization of knowledge and the development of the psychological processes resulting in knowledge. To this end, they have devoted their efforts to the study of children to build a model of the development of logical thought processes.

Piagetian theory is in part a stage-dependent theory, describing cognitive development as following an orderly and invariant sequence from infancy through adolescence. Each developmental stage occurs during a general age range, but these ages are not absolutes. The basic concept of a stage theory is the notion of sequential change rather than age specification. Piaget's model suggests qualitative differences in thinking for each developmental stage. There are four basic stages in this model, each bearing its own special characteristics, and each a necessary prerequisite for the next.

The first stage of development is the sensori-motor period, spanning the age range from birth to approximately two years. This stage is preverbal, characterized by the gradual expansion of sensorimotor reflexes which provide the infant with practical knowledge of the world around him. The major accomplishment of this first stage of cognitive development is the acquisition of the concept of object permanence. Briefly, the infant moves from believing that an object exists only when it is within his perceptual field, through locating objects by random search, to a rudimentary understanding of cause and effect which allows him to understand serial displacement and find the object in its final place without looking at each step along the way. The practical basic knowledge about the world developed during the sensori-motor period forms the substructures of later representational knowledge.

At approximately two years of age the child moves into the stage of preoperational thinking. This stage marks the beginning of organized language and symbolic function and, as a result, thought and representation develop. During the next five years or so, the child expands his horizons but his thinking is basically egocentric in nature. He is perceptually oriented, does not use logical thinking, and therefore cannot reason by implication. Lacking the ability to coordinate variables, the child has difficulty in realizing that an object has several properties, and is commonly satisfied with multiple and contradictory statements. Since the concept of conservation is not yet developed, the child lacks operational reversibility in thought and action.

Movement into the third stage of development, the period of concrete operations, generally coincides with the early elementary school years. The child moves gradually through this period, developing increasingly sophisticated cognitive abilities until approximately the onset of adolescence. The major difference between the period of concrete operations and the earlier period of preoperational thought is "that the older child seems to have at his command a coherent and integrated cognitive system with which he organizes and manipulates the world around him" (9:165). During the elementary grades the child's thinking is characterized as concrete rather than abstract, but now includes the capability of performing elementary logical operations and making elementary groupings of classes and relations. The concepts of conservation develop generally in the order of number, substance, weight, and volume.[1] Logical operations are applied to concrete objects, but the child's thinking is still limited by his ability to proceed only from one step to the next without relating each link to all others.

Finally, at about eleven or twelve years of age, the fourth and final stage of cognitive development, formal operations, emerges. The stage of formal or abstract thought is marked by the appearance of hypothetical-deductive reasoning based upon the logic of all possible combinations.

> This period is characterized in general by the conquest of a new mode of reasoning, one that is no longer limited exclusively to dealing with objects or directly representable realities, but also employes 'hypotheses;' in other words, propositions from which it is possible to draw logical conclusions without it being necessary to make decisions about their truth or falsity before examining their implications (24:33).

This propositional thinking is accompanied by the development of the ability to perform controlled experimentation marked by the use of interpropositional logic (combining propositions by conjunction, disjunction, negation, and implication).

Piagetian theory also has some stage-independent aspects regarding the nature of the human cognizer and the general principles by which the individual changes his state in the course of development. The basic equipment of the knower at any given stage of development consists of the biologically given functional invariants of organization and adaptation: assimilation and accommodation. The essence of cognitive development is the succession of discontinuous cognitive structures which arise across a continuous operation of the functional invariants. The outgrowth of the Piagetian work is the view that knowledge is constructed as a result of a dynamic interaction between the organism and his experiential environment.

---

[1] Validation studies of the conservation processes offer both supporting and contradictory evidence for the specific sequences suggested by Piaget (8, 44, 21, 37, 38, 39, 40, 41, 42).

> To my way of thinking, knowing an object does not mean copying it--it means acting upon it. It means constructing systems of transformations that can be carried out on or with this object. Knowing reality means constructing systems of transformations that correspond, more or less adequately, to reality. They are more or less isomorphic to transformations of reality. The transformational structures of which knowledge consists are not copies of the transformations in reality; they are simply possible isomorphic models among which experience can enable us to choose. Knowledge, then, is a system of transformations that become progressively adequate (24:15).

This view is in opposition to theories of learning whch rely on imitation as the fundamental process of acquiring knowledge and as such has implications for educational methodology.

In brief, Piagetian theory attributes development to four major factors:

> . . . first of all, maturation, in the sense of Gesell, since this development is a continuation of the embryogenesis; second, the role of experience of the effects of the physical environment on the structures of intelligence; third, social transmission in the broad sense (linguistic transmission, education, etc.); and fourth, a factor which is too often neglected but one which seems to me fundamental and even the principal factor. I shall call this the factor of equilibration or if you prefer it, of self-regulation (26:178).

Thus development, to Piaget, is a process concerning "the totality of the structures of knowledge" (26:176) occurring in a step-by-step fashion as a result of the mechanisms of assimilation and accommodation. Learning, on the other hand, is restricted to specific situations and explained by development. Therefore, in order to create an environment for learning, the teacher must understand the processes of development.

Piagetian theory does not include a prescription for curriculum development, nor does it provide a specific model for the classroom.

It is not a pedagogic theory although there are clear implications for educational practice within it. It does not tell the teacher exactly what to do or how to do it. However, Piaget's work, and the work of the entire Geneva group, continues to be of interest and value to science educators as we strive to build a bridge between theory and practice.

Implications

There are at least four ways Piagetian theory can be applied to science education. First, it may be possible to develop a useful scale of intellectual development based on the Piagetian tasks. There are several such tests being devised including those of Pinard and Laurendeau (28) and Raven (30). Although there is always a need for improved assessment procedures, this area of diagnostic evaluation will not be discussed further in this paper. The second area of fruitful application is that of curriculum development and implementation. The third is related to the creation of a classroom environment which promotes intellectual development. Finally, Piagetian theory has implications for teacher development. These latter three applications will be the primary focus of our discussions. A prerequisite to the application of Piagetian theory in these three areas is a knowledge of the child's level of logical-operational thought.

The first major implication is that there is NO recipe—although many new science curriculum guides attempt to provide recipes. However, in many cases, it seems that psychological concepts have been tacked on (ad hoc) to the science curriculum. These guides have limited effectiveness because they do not require the teacher to understand (and react to) the children's thinking. The trouble with many new science curricula is that they are essentially teacher-proof—they are spelled out to the nth degree. If the children do not respond the way the teachers' guide says they will react, teachers may be uncertain as how to proceed if they have not developed the techniques to respond spontaneously. These teachers really do not understand the children. It is a temptation simply to memorize the list of questions in the curriculum guide rather than internalize the curriculum so that it becomes a part of the teacher's own structures. If the teachers really understood the principles they were teaching, then they would not have to depend upon a prepared list of questions and activities. They would be able to move easily from one activity to another, depending upon the needs of the child. They would be the curriculum-proof teachers (33).

Basically there is nothing wrong with the various kinds of science programs which provide materials. The implication is that the very strict structure of, for example, Science - A Process Approach (SAPA), where there are correct and incorrect answers in the competency measures (tests), really is emphasizing a product rather than a process —even though it is called process education. Our educational system is still based on a competitive system of rewards and punishments, even in the non-graded schools. Evaluation is primarily of the product, rather than the processes by which it is achieved.

"We have a habit of thinking in terms of right and wrong answers and equating intelligence with the ability to pass or to fail specific test items" (18:226). However, the focus should be on the kinds of questions asked rather than on specific, predetermined answers to didactic questions.

> The reason that it is important for us to let the child go from one stage after another of being wrong is that wrong notions usually contain a certain amount of correctness. For example, to predict whether something will sink or float, it is not entirely wrong to consider heaviness as the determining factor. This reasoning is not entirely wrong, it is only incomplete (18:226).

The point of the "wrong answer is the right answer" is that in demanding the right answer at every level we are demanding something of which the child is not capable. He may even learn to give the right answer for the reward but the knowledge does not become internalized. It is not part of his structure. What should happen is a succession of accepting wrong, i.e., incomplete, answers which eventually approach the right, i.e., more advanced solution to the problem.

Curriculum. Science education has been under attack in modern times on various grounds: for failing to solve some problems while having demonstrated the capability to overcome others--for achieving both too much and too little. The imposition of a ready-made science curriculum has an "implied assumption . . . that new materials alone can constitute a new curriculum sufficient to achieve significant educational improvement" (43:157). This imposition usually comes from the superintendent of schools, although it may be "approved" by a local curriculum committee. The teachers in "enlightened" districts are given workshops and consultant aid for the new science curriculum, frequently in after school hours. Teachers then use the new program in their classroom. "The paradox is that despite the cost and effort, the material will not have changed the structure of the teaching itself . . . since no one at any point has questioned the organization of the school itself, its implicit cognitive theory, and the teaching method" (43:157).

One of the trends of American curriculum development is the emphasis on content changes with various topics being taught at an earlier age than previously. In general, the influence of psychological approaches seems to be minimal.

> All of these innovations have been approached with the same principles of pedagogy that we have been using for a long time: emphasizing exactly what you want the student to do, teaching him to do it, providing him opportunities for practice, and rewarding him when he does the job right (3:204).

While those preparing new science curricula have considered Piaget, we cannot say that Piaget has inspired the curriculum development itself. However, minimal, and for better or worse, Piaget is credited with a major role in modern science curricula (11:5). On the elementary science level the influence of Piagetian theory is clearly visible in the Science Curriculum Improvement Study (SCIS) program. Piaget is given credit by SCIS for the most extensive investigations and the most comprehensive theories of the development of abstract thought. The stages of intellectual development are briefly described for the teacher followed by a discussion of "How Children See the World" and a description of how SCIS develops logical operations (17:26-31).

> The program of the Science Curriculum Improvement Study is aimed . . . to help the children's intellectual development reach the formal operational level with a repertory of concepts that to a certain extent is different from the repertory which is part of the common sense and the natural philosophy in the population at large (19:236).

In spite of this clear influence by Piaget there are some (20:11) who question the appropriateness of labeling SCIS a Piagetian program. This criticism follows from a consideration of the three types of SCIS lessons: exploration, invention, and discovery. Exploration lessons leave the children somewhat on their own to explore and discover. The invention lesson is clearly teacher-directed: one introduces or "invents" a new concept. This is the non-Piagetian aspect that is questioned above because SCIS invention lessons are done by the teacher rather than the child. "The child must, at least for a short time, accommodate his thought to that of the teacher" (20:9). This is inherently dangerous because the child may never go beyond that comfortable, verbal reward. Verbal education can become a game with the child. "Children should be allowed a maximum activity of their own, directed by means of materials which permit their activities to be cognitively useful. In the area of logico-mathematical structures, children have real understanding only of that which they invent themselves. . ." (20:10-11). Although the linguistic transmission of which Piaget speaks could be between adult and child, thus making the invention lesson consistent with the Piagetian approach, Piaget's writings (24) specifically detail the importance of peer interaction, rather than adult-child interaction. It may be, therefore, that Kaufman and Konicek are overly critical of this aspect of the SCIS program.

The third type of SCIS lesson, the discovery lesson, is designed to help the children discover the usefulness of the new concept. The goal is not to get a "right" answer but to provide opportunities for the teacher to appraise the level of the children's thinking.

In fact, the question can be raised "Should any science curriculum program be labeled Piagetian?" Since the focus of Piaget's work is the nature of knowledge, and not curriculum, such programs can incorporate some of the Piagetian principles. However, there remains no direct translation. There can be many science curricula which differ widely, especially in content, which incorporate Piagetian principles. Labeling a particular science curriculum as Piagetian can be viewed as an attempt to obtain a preordained seal of approval, especially when one considers the current emphasis on Piaget in the literature of science education.

The Early Childhood Curriculum is advertised as "A Piaget Program." It is described as

> . . . a nursery school and kindergarten program designed to foster the development of logical thinking processes in four to six year olds. Based upon the research of Jean Piaget the 22 materials provide over 100 activities in Classification, Number Measurement and Space (Conservation), and Seriation (Learning Research Associates program description).

One must be extremely cautious in using these materials not to attempt to teach these operations. There is no evidence available that children need to be taught the operations and there is some evidence that attempts to teach operations directly fail to produce significant changes in cognitive structures (37, 38, 39, 40, 41, 42).

In addition to these efforts in the United States, there has been a vigorous movement in Great Britain "to effect a liason between Piaget and pedagogy, particularly as regards curriculum planning" (9:366).

The Nuffield Foundation in England jointly sponsored Science 5/13, a project to help children between the ages of five and thirteen to learn science. Their "Objectives for children learning science" clearly show the influence of the developmental stages of Piaget. The objectives of Science 5/13 have been arranged in stages that are compatible with (but not identical to) Piaget's view of children's development from preoperational through concrete operational to formal operational thought. Unfortunately, this material is not well known in the United States.

Another well known American program is Science - A Process Approach (SAPA) which generally follows the learning hierarchy theory of Gagné in which each step is a prerequisite for future learning of a more difficult and complex behavior. We are familiar with only one attempt (45) to interrelate Piaget and SAPA. Each of the basic processes of SAPA is somehow analyzed and matched with the Piagetian stages of development. The resulting matrix is then supposed to indicate the minimum appropriate stage and age for the teaching of each process. We do not see this as fruitful since it adds nothing to the teaching or content of the program. Nevertheless, within the hierarchical and highly structured SAPA program, there is no reason why the teacher cannot apply some of the Piagetian principles by being sensitive to the questions, interests and ideas of the child. In particular, the Piagetian technique of having children justify their responses could give the SAPA teacher insight into the child's thinking and encourage the child to test his ideas.

The Elementary Science Study (ESS) represents the other end of the spectrum of elementary science programs arranged according to structural organization. The ESS units have no absolute goal of teaching a "concept" or a "process." There are two general guidelines for most of the ESS units.

> One is that the children use materials themselves, individually or in small groups, often raising the questions themselves, answering them in their own way, using the materials in ways the teacher had not anticipated, and coming to their own conclusions. In Piaget's terms, they are acting on things, transforming things, and learning about them by seeing the effects of these actions and transformations. The other is that we try to create situations where the children are called upon to talk to each other. One of Piaget's fundamental notions is that of egocentrism which is characteristic of small children. We might say this means not realizing that there might be some point of view different from their own (4:242).

Nevertheless, in speaking of ESS, Duckworth has stated that "the extent to which there has been direct influence of cognitive research in our work . . . has been quite limited" (4:241).

To the extent that the "new" science programs are not lecture-method, textbook oriented approaches, but are activity centered approaches where "children learn by doing," they can be said to have been influenced by Piaget's work. Because children are in the concrete-operational period of development during the elementary school years, these programs provide concrete-experiences involving the manipulation of concrete materials. However, they may not have taken into account Piaget's statement that activity need not only be concrete but that activity can also be mental, and that the beginnings of the logical-mathematical structures start in the sensori-motor period through action. Thought is not dependent upon language; language is, in fact, dependent upon the logical structures. That linguistic or semantic level is only a reflection of the logical structures is a factor that many new science curricula do not take into account. For example, the young child with primitive logical structures may not understand sentences using "if . . . then" reasoning.

Even though these new programs are hands-on, activity oriented, with a teaching method described as the inquiry method, the inquiry method itself depends upon language. The teacher asks for verbal answers from children, perhaps using a language structure that is beyond the children's logical structure. Although the programs and the various teacher's guides outline the stages and may even say something about the activity approach, they don't get at the notion of organizing the environment. The materials may not always be available for the children. The lesson may be guided not by the child's need to know but rather by the prescribed order of the curriculum or whatever the teacher may select.

Likewise, differences in rates of learning are often not taken into account in our educational structure. How often do children really have sufficient time for learning science? The slower child may not be given enough time with the materials to make the experience useful. Teachers may not know how to diagnose where the children are, and may therefore simply assume that all children in the classroom have the prerequisite cognitive structures necessary to understand the lesson. The difficulty, however, may be not so much in the curriculum itself but in how it is implemented. Suppose the child has been exposed to 25 ESS units by fourth grade. Further suppose that 10 of these were not assimilated into his cognitive structures and he needs further exposure to these 10 units, to play with them--to "mess about" (12). Our present system of education does not provide for this unless the child repeats the grade.

In Piagetian terms, the teacher does not know what the child knows. If one is looking for a science curriculum that creates a learning environment consistent with Piaget's ideas, none will do so directly. What is required is using a curriculum with a great deal of sensitivity on the part of the teacher, a great deal of listening to children, and a great deal of familiarity with Piaget's theory in order to know what kinds of structures the children have and what kinds they do not possess. The teacher should also know what kinds of structures are necessary prerequisites for a particular activity. Perhaps certain activities can be done at a variety of levels where the child need not have any prerequisite structure in order to be able to work with the materials and still get something out of the experience. However, we are in a system of accountability and teachers feel pressured to be able to say and demonstrate that their students have achieved specific goals.

Once again the implications of such an approach are far wider than just science education. Nevertheless, one of the difficulties that science education is facing is that when one moves into a program like this, one violates the system. Noise and clutter are, of necessity, increased as children interact in a more complex classroom situation. Greater flexibility in grouping is required as some children work alone and some in small groups. Systems of evaluation need to be changed as traditional letter grades are not reflective of experiential learning. Although some elementary schools do not give A, B, C-type letter grades, intermediate schools using experiential science curricula such as the Intermediate Science Curriculum Study, Earth Science Curriculum Project, or Environmental Science are currently presented with such a problem.

Ten years ago, at a Conference on Cognitive Studies and Curriculum Development, it was anticipated that "discussions would bring out ways of applying the findings of the psychological researchers to contemporary curriculum problems" (31:252). However, this "pedagogical bridge" was not built at that time. It appears to us that this bridge remains to be constructed.

Classroom Environment. The notion that cognitive development proceeds by four factors, one of which is social transmission, has implications for classroom structure, i.e., there should be a cooperative structure in the classroom with constant, rather than occasional, interaction among the children. According to this view, children do not learn by sitting still and listening. They learn by being active, not only with materials but with each other. "From his earliest writings (e.g., the first five books), he [Piaget] has stressed the paramount importance of interactions with peers as the principal vehicle by which the child is liberated from his egocentrism" (9:369). Movement and development can proceed as children at slightly varying levels, with variations in intellectual structures, help point out contradictions in each other's thinking. They learn from each other particularly if they are in a transitional stage where they are ready to move on. They are as likely to learn from the child whose logical structures are similar, as from the teacher who is really operating at a wholly different level--the level of formal operations.[2] It is extremely difficult to translate adult thinking at the formal operational level into any kind of curriculum. It is perhaps easier for children to learn from each other because their thinking is more similar.

> Experience is always necessary for intellectual development . . . But I fear that we may fall into the illusion that being submitted to an experience (a demonstration) is sufficient for a subject to disengage the structure involved. But more than this is required. The subject must be active, must transform things, and find the structure of his own actions on the objects.
>
> When I say "active", I mean it in two senses. One is acting on material things. But the other means doing things in a social collaboration, in a group effort. This leads to a critical frame of mind, where children must communicate with each other. This is an essential factor in intellectual development. Cooperation is indeed co-operation (4:174).

A classroom designed to be consistent with the Piagetian model is one in which activity, derived from the materials in the physical environment, is central, spontaneous, and occurs in a comfortable emotional climate. Learning tasks must be analyzed in terms of the operations implicit in them, and materials must be arranged so that the operations can be carried out by the students. The teacher must be sensitive to each child's needs and cognitive level in order to be able to ask the right kinds of questions and see to it that the child carries out the operations. While discovery learning seems to be implied by much of what Piaget has written, children do not discover totally on their own. This means that the teacher must construct an environment which promotes discoveries, a "classroom for thinking."

---

[2] RappeduCher (private interview) claimed that failure of adults to solve Piagetian formal problems is a function of lack of experience with those kinds of questions rather than absence of formal operational structures.

One of the major factors of classroom environment is the affective climate. Most of the interpreters of Piagetian theory into science education programs have focused solely on the cognitive aspects of his theory, since that is the area which has been clearly delineated. However, the affective factors have not been taken into account. Piaget himself states that the cognitive aspect and affective aspect of behavior are "inseparable and complementary" (27:21). He also notes that studying affect is perhaps more difficult than studying cognition. Nevertheless, Michael Huberman (private interview), professor at the Institute in Geneva, sees the absence of concern with affective factors as an important lack in our work with the Piagetian model here in the United States. He notes:

> In the tests that we've run we have found children who were judged incapable of performing cognitive tasks, although their age would have suggested that they were able to . . . were perfectly able to do those tasks, but the affective factors, the emotional factors, meant that they were not willing to have the kind of risk taking behavior, even on a modified level, which enables them to show their ability to do these tasks or even enables them to, as Piaget would say, consolidate their schema. Now when you work with Piagetians, they'll do the tests. They'll watch the child, they'll investigate the child, (and) they'll say the child does or does not have this particular schema (15).

Thus when we apply Piagetian tasks blindly as a means of assessing cognitive level, we may very well be misled because of emotional factors which interfere with performance. A further implication of the importance of affective factors is the necessity of making the classroom a safe place for a child to risk making mistakes, and creating an environment which is accepting of the child.

Related to the creation of a comfortable classroom environment as well as a cognitive implication of the theory is the willingness of the teachers to "accept 'wrong' answers that are wrong in the absolute sense but appropriate and normal for a child at a given age . . ." (35:9). The child is far more likely to benefit, both cognitively and emotionally, from many experiences which permit and encourage him to see contradictions in his thinking than from the teachers' pointing out his errors and providing the correct explanation.

Another area of the Geneva group's work which has implications for the teacher stems from their research in linguistics. The findings indicate that a child's syntactic level is based upon his logical operations. Thus when children are not responsive to the teacher or seem to lack interest, it may be because teachers are expressing themselves in ways that the children cannot understand. It is not a question of vocabulary, but a question of syntactic level. If there are too many conjunctions in a sentence the young child will not be able to assimilate the sentence into his existing cognitive structures.

When asked specifically what should be done in the classroom, RappeduCher, another member of the Geneva group, said

> Make the classroom a very pure place. I think there's a bit too much that goes on in the classroom that is perhaps not necessary. Decide upon what you want to do and try and purify the classroom (29).

He further suggested keeping the children's activities closely connected to their ongoing experiences and problems in the classroom, rather than to remote events.

What seems to emerge from careful consideration of Piaget's work and that of his colleagues is a plea for a human environment in the classroom, filled with opportunities for experiencing the physical and the social world, with equal emphasis on the cognitive and affective aspects of the child. This equal emphasis aspect of the Piagetian approach is in sharp contrast to many of the affective education programs developed in the last decade which have lost sight of the importance of the development of logical thought in their attempt to provide for the child's emotional needs.

Teacher Development. The question of how to put into practice some of the fine ideas generated by curriculum specialists and affective program developers remains an important issue. The major implication of the Piagetian theory regarding the way children learn is the requirement of active methods. Science educators were among the first to accept this idea and translate it into guides for teachers so that all of the new science curricula are hands-on, activity oriented programs. Teachers are advised to shift into the discovery method, the inquiry method, etc. Frequently, teacher training courses "teach" students to use these methods by having them read about them or by telling them how to do it. Many pre-service and in-service courses in the teaching of science, however, do attempt to use an active method themselves, allowing teachers to experience the methods it is hoped they will use. Nevertheless, it is our contention that too often these methods are not adequately used in the classroom. In an attempt to explain why receptive methods of teaching continue despite far greater theoretical understanding of the value of active methods, Piaget comments:

> . . . no great progress has been made in putting them into practice, simply because the active methods are much more difficult to employ than our current receptive methods. In the first place, they require a much more varied and much more concentrated kind of work from

> the teacher, whereas giving lessons is much less tiring and corresponds to a much more natural tendency in the adult generally, and in the adult pedagogue, in particular. Secondly, and above all, an active pedagogy presupposes a much more advanced kind of training, and without an adequate knowledge of child psychology (and also, where mathematics and physics are concerned, without a fairly good knowledge of contemporary developments in those disciplines), the teacher cannot properly understand the students' spontaneous procedures, and therefore fails to take advantage of reactions that appear to him quite insignificant and a mere waste of time (25:69).

There is, in addition, some evidence that "discovery learning" has become the watchword of our "faith" even if it is not implemented successfully. The result of this commitment is to assume that there is no other effective method. Elkind (8) points out that learning by discovery is clearly an important mode of learning but not necessarily the only mode nor the best mode for all materials and children at all levels of development. There is no question that discovery learning is appropriate in science. However, the method chosen should be directed by the nature of the material and the learning style of the child.

Perhaps even more important is the misuse of the discovery method. Kamii points out that "even when a discovery method is advocated, 'discover' usually means to discover only what the teacher wants to have discovered" (18:200).

Piaget himself notes that it may be possible to strike a balance between learning activities and methods of teaching. In discussing the possible value of teaching machines, if they are developed far more creatively than simply transposing poor textbooks into programmed materials, he says the following:

> Generally speaking, since every discipline must include a certain body of acquired facts as well as the possibility of giving rise to numerous research activities and activities of rediscovery, it is possible to envisage a balance being struck, varying from subject to subject, between the different parts to be played by memorizing and free activity. In which case, it is possible that the use of teaching machines will save time that would have been needlessly wasted by more traditional methods and therefore augment the number of hours available for active work. So that, particularly if the periods of active work include team work, with all that such work entails in the way of mutual incentives and checks, while the machine presupposes an essentially individualized kind of work, then this balance would at

> the same time be realizing yet another necessary kind of balance: that between the collective and individual aspects of intellectual effort, both so essential to a harmonious school life (25:78-79).

In discussing various aspects of the classroom, its curriculum, its environment, and the methodology for creating both, the one constant factor, bearing the fullest responsibility for constructing a "classroom for learning," is the teacher. As an architect of such an environment and a facilitator of learning through the use of a variety of methods, the teacher needs a deep and basic understanding of children in general and of each individual child in the class.

Unfortunately it is easy to "cover" Piaget inadequately in a one semester psychology course designed for pre-service teachers. In theoretical principle these courses may be in complete agreement on the importance of teachers acquiring an understanding of the child. But whenever a one semester course in child psychology is delivered by the lecture method with little or no opportunity for interaction with children, prospective teachers do not gain the depth of understanding which they will need in the classroom. Teachers can, however, make a concerted effort to increase their own knowledge about children as they interact with them in the classroom.

Beyond an understanding and appreciation of children, teachers must develop confidence in their own ability to be discoverers, creative thinkers, and spontaneous facilitators of learning.

> Yet the idea that a teaching situation provides an outlet for a teacher's own creativity as well as for the spontaneous activity of the child is still not well developed. In fact, the teacher should be convinced that his work holds out the possibility of continuous self-reorganization, new construction, and discoveries, and that his discipline contains an infinite number of possibilities for theoretical deepening and technical improvement. What makes him a teacher in the most profound sense is not a particular material but a real understanding of the problems of intellectual development, relevance for his work, their practical implications, and the recognition that he alone can make his work a meaningful way of transmitting knowledge (43:170-171).

Conclusion

> The principal goal of education is to create men who are capable of doing new things, not simply repeating what other generations have done--men who are creators, inventors, and discoverers. The second goal of education is to form minds which can be critical, can verify, and do not accept

> everything they are offered. The great danger today is from slogans, collective opinions, ready-made trends of thought. We have to be able to resist individually, to criticize, to distinguish between what is proven and what is not. So we need pupils who are active, who learn early to find out by themselves, partly by their own spontaneous activity and partly through material we set up for them; who learn early to tell what is verifiable and what is simply the first idea to come to them (4:139).

We have not set ourselves an easy task. The application of Piagetian theory to the classroom has extensive implications. While offering, on the one hand, the promise of facilitating intellectual growth, it also offers impetus for promoting a healthy climate for teaching and learning. There are many who are searching and striving for a pedagogical model based on Piagetian theory but the "pedagogical bridge" remains under construction.

In order to have a "Piagetian" school, we must do more than just rewrite curricula and retrain teachers. We must revolutionize the total educational system. To simply have a Piagetian approach in the teaching of science might further the cause of science education but it is not the whole answer. In fact, such an approach could not be limited to science education because it requires a change in attitude on the part of the teacher which would permeate all of her teaching. Therefore, while we speak specifically to science educators in this paper, we nevertheless speak to all educators and the total educational program.

In addition, we cannot forget that the school is a social system with a variety of factors operating to influence what happens in the classroom. Teachers and students, with whom we have been primarily concerned here, are affected by administrators, boards of education, parents, and the community at large. Unfortunately the teacher does not always have the autonomy in the individual classroom to make it into a Piagetian classroom or perhaps any other kind of classroom without the approval of at least some of these forces. Innovation requires the support of these political and social forces.

Application of Piagetian theory to science education requires considerable innovation. Putting such a rich theory into practice does not mean teaching operations, nor does it mean speeding up the rate of intellectual development. It does require the adoption of a philosophy of education based on the principle of an orderly progression of cognitive development controlled by the child as he experiences the environment and moves forward by the process of equilibration of his mental structures. It also requires a school where interaction is a must, activity is directed but flexible, and the teachers are encouraged to be creative architects of the learning environment.

The basic question was, Should Piagetian theory be applied to science education? Our conclusion is a qualified yes--Piagetian theory can have direct application in science curricula, classroom environment and teacher development. The implementation of this application will require further cooperation between basic and applied researchers in a continued effort to refine the descriptions of the child as learner and the prescriptions for effective learning.

REFERENCES

1. Case, R. "Piaget's Theory of Child Development and its Implications," Phi Delta Kappan, 55:20-25, 1973.

2. Chittenden, E. A. "Piaget and Elementary Science," Science and Children, 8:9-15, 1970.

3. Cronbach, L. J. "Learning Research and Curriculum Development," Journal of Research in Science Teaching, 2:204-207, 1964.

4. Duckworth, E. "Piaget Rediscovered." In The ESS Reader. Newton, Mass.: Education Development Center, 1970.

5. Dyrli, O. E. "Piaget Takes a Teacher's Look with Eleanor Duckworth," Learning, 2:22-27, 1973.

6. Elkind, D. "Piaget and Science Education," Science and Children, 10:9-12, 1972.

7. Elkind, D. A Sympathetic Understanding of the Child: Birth to Sixteen. Boston: Allyn & Bacon, 1971.

8. Elkind, D. "Children's Discovery of the Conservation of Mass, Weight, and Volume: Piaget Replication Study II," Journal of Genetic Psychology, 98:219-227, 1961.

9. Flavell, J. H. The Developmental Psychology of Jean Piaget. Princeton, N.J.: D. Van Nostrand Company, Inc., 1963.

10. Fontaine, T. D. "Federal Programs for the Improvement of School Science and Mathematics," Science Education, 54:209-211, 1970.

11. George, K. D., et al. Elementary School Science: Why and How. Lexington, Mass.: D.C. Heath & Company, 1974.

12. Hawkins, D. "Messing About in Science," Science and Children, 2:5-9, 1965.

13. Holt, J. Freedom and Beyond. New York: E. P. Dutton & Company, Inc., 1972.

14. Howe, A. and D. Butts. "The Effect of Instruction in the Acquisition of Conservation of Volume." Paper presented at the annual meeting of the National Association for Research in Science Teaching, Minneapolis, Minnesota, March 6, 1970.

15. Huberman, M. L. L'Institute de Psychologie et des Sciences de l' Education, Geneva. Interview with National Science Education Leaders Goodwill People-to-People Delegation, May 23, 1974.

16. Inhelder, B. and J. Piaget. The Early Growth of Logic in the Child. New York: Norton, 1969.

17. Jacobson, W. and A. Kondo. SCIS Elementary Science Sourcebook. Berkeley: University of California, 1968.

18. Kamii, D. "Pedagogical Principles Derived from Piaget's Theory: Relevance for Educational Practice," Piaget in the Classroom, M. Schwebel and J. Raph (eds.). New York: Basic Books, Inc., 1973.

19. Karplus, R. "The Science Curriculum Improvement Study--Report to Piaget Conference," Journal of Research in Science Teaching, 2:236-240, 1964.

20. Kaufman, B. A. and R. D. Konicek. "The Applicability of Piaget to Contemporary Curriculum Reform." Paper presented at the 47th annual meeting of the National Association of Research in Science Teaching, Chicago, April 15, 1974.

21. Lovell, K. and E. Ogilvie. "A Study of the Concept of Conservation of Substance in the Junior School Child," British Journal of Educational Psychology, 30:109-118, 1960.

22. Ozinonu, A. K. "Is American Science Education at the Crossroads?" Science Education, 57:219-225, 1973.

23. Piaget, J. The Child and Reality: Problems of Genetic Psychology. New York: Viking Press, 1973.

24. Piaget, J. Genetic Epistemology. New York: Columbia University Press, 1970.

25. Piaget, J. Science of Education and the Psychology of the Child. New York: Orion Press, 1970.

26. Piaget, J. "Development and Learning," Journal of Research in Science Teaching, 2:176-186, 1964.

27. Piaget, J. and B. Inhelder. The Psychology of the Child. London: Routledge and Kegan Paul, 1969.

28. Pinard, A. and M. Laurendeau. "A Scale of Mental Development Based on the Theory of Piaget: Description of a Project," Journal of Research in Science Teaching, 2:253-260, 1964.

29. RappeduCher, E. L'Institute de Psychologie et des Sciences de l' Education, Geneva. Interview with National Science Education Leaders Goodwill People-to-People Delegation, May 24, 1974.

30. Raven, R. J. "The Development of a Test of Piaget's Logical Operations," Science Education, 57:366-385, 1973.

31. Rockcastle, V. N. "Looking Back at the Conference," Journal of Research in Science Teaching, 2:252, 1964.

32. Rogers, C. R. Freedom to Learn. Columbus, Ohio: Charles E. Merrill, 1969.

33. Romey, W. D. "The Curriculum-Proof Teacher," Phi Delta Kappan, 54:407-408, 1973.

34. Saadeh, I. Q. "Direction of the New Science Curricula: An Appraisal and an Alternative," Science Education, 57:247-262, 1973.

35. Schwebel, M. and J. Raph. Piaget in the Classroom. New York: Basic Books, Inc., 1973.

36. Sigel, I. Child Development and Social Science Education. Part I: The Problem. Publication #111 of the Social Science Consortium. Boulder: University of Colorado, 1966.

37. Smedslund, J. "The Acquisition of Conservation of Substance and Weight in Children. I. Introduction," Scandinavian Journal of Psychology, 2:11-20, 1961.

38. Smedslund, J. "The Acquisition of Conservation of Substance and Weight in Children. II. External Reinforcement of Conservation of Weight and of the Operations of Addition and Subtraction," Scandinavian Journal of Psychology, 2:71-84, 1961.

39. Smedslund, J. "The Acquisition of Conservation of Substance and Weight in Children. III. Extinction of Conservation of Weight Acquired 'Normally' and by Means of Empirical Controls on a Balance Scale," Scandinavian Journal of Psychology, 2:85-87, 1961.

40. Smedslund, J. "The Acquisition of Conservation of Substance and Weight in Children. IV. An Attempt at Extinction of the Visual Components of the Weight Concept," Scandinavian Journal of Psychology, 2:153-155, 1961.

41. Smedslund, J. "The Acquisition of Conservation of Substance and Weight in Children. V. Practice in Conflict Situations Without External Reinforcement," Scandinavian Journal of Psychology, 2:156-160, 1961.

42. Smedslund, J. "The Acquisition of Conservation of Substance and Weight in Children. VI. Practice on Continuous Versus Discontinuous Material in Conflict Situations Without External Reinforcement," Scandinavian Journal of Psychology, 2:203-210, 1961.

43. Voyat, G. "The Development of Operations: A Theoretical and Practical Matter," Piaget in the Classroom, M. Schwebel and J. Raph (eds.). New York: Basic Books, Inc., 1973.

44. Wohlwill, J. F. and R. C. Lowe. "An Experimental Analysis of the Development of Conservation of Number," Child Development, 33:153-167, 1962.

45. Wood, D. A. "The Piaget-Process Matrix," School Science and Mathematics, 74:403-412, 1974.

THE IMPLICATIONS OF PIAGETIAN THEORY
FOR SCIENCE EDUCATION:
A REACTION

Everett S. Stallings
Winthrop College
Rock Hill, South Carolina 29733

Introduction

When the opportunity to serve as a reactant to this chapter was first presented to me, I was under the impression that the discussion was to serve the function of a "devil's advocate" by taking an alternative viewpoint to that presented in the position paper. This would be a relatively simple task if one either was neutral or honestly disagreed with the argument presented in the paper. However, in the current case, as I am basically "friendly" to the position taken by the chapter authors, I would have to develop the forensic skills of the classic Sophist who could debate with equal vigor from either side of a diametrically opposed argument. I doubt that I could carry out such an assignment even if I wished to. I can find little to criticize in the chapter; however, it does occur to me that the other psychological models presented in the introduction section of the chapter are dismissed from the discussion without adequate treatment as to the strengths and weaknesses of each model. In particular, concern must be expressed regarding the discussion of the Rogerian-Humanistic Model. A case will be made that the cognitive development model of Piaget and the humanistic school of psychology serve to reinforce each other and to produce a rationale for education of both the cognitive and the affective aspects of science education.

A discussion of the implications for science education should be couched in terms of desirable goals for science education. The question should be less concerned with which psychological model is most intellectually appealing and more concerned with which model is the most consistent with the goals of the instructor. This implies that a great deal of research is needed to establish the bridge between theory and practice for which the chapter authors call. At least one such effort is underway and will be discussed later, but for the present the key question is twofold: a) What are desirable goals for science education?, and b) Which of the various psychological models are most compatible with these goals?

Goals and Objectives for Science Education for Children

It is suggested that the following goals and objectives (8:137-139) are worthy of pursuit in the science education of children. Since the chapter authors chose to slant their viewpoint towards the perspective of the developing child, the remarks that follow will also focus mainly on this aspect. However, one's goals for the education of a technician might be rather different (skill oriented) and one could borrow heavily from Gagné to meet those ends.

> Learning how to learn is of major importance to the child and self-actualized learning is a major goal of education. Therefore science education for children should have the following goals:
>
> (a) It enhances the thinking ability of the child. It provides activities compatible with pre-operational, concrete operational, and formal operational thought in the pursuit of investigations of the environment or the solutions of problems.
>
> (b) It enhances the child's belief that he can interpret and manipulate his own environment - that he is a part of his environment and dependent upon it.
>
> (c) It facilitates for each child the development of a positive self concept with regard to independent learning and the manipulation of his environment.
>
> (d) It facilitates individual development of interests, attitudes, personality and creativity which enhance the continued development of individuality in the learner.
>
> (e) It facilitates the child's tendency to accept the existence of individuals who have ideas and values which are different from his own.

The preceding goals provide a conceptual framework from which the following broad objectives (8:137-139) can be derived. It should be pointed out that specific objectives may be associated with sets of materials or combinations of sets of materials. However, the facilitation of the overall goals requires that the objectives should not limit the independence of the child in the classroom.

> A beginning science program should have objectives associated with both affective and cognitive learning. The cognitive objectives should be associated with the goal of communicating to children what science is and how creative and systematic thinking relates to solving self-perceived problems. The child who completes a K-8 science program should be able to design activities (without suggestions) and do activities (without instructions) in which he:
>
> (a) manipulates objects in a way that is dependent upon the properties of the objects.

(b) identifies relationships among the properties of "static objects" or among the factors which affect the behaviors of "dynamic systems."

(c) manipulates objects to test the usefulness of the relationships which he has identified.

The affective objectives should be associated with the development of a positive self concept with regard to independent learning. The child who completes a K-8 science program will:

(a) identify himself as a person who can be successful in science and who chooses to use science.

(b) describe science in terms of activities which make sense to him.

(c) state his own explanations for natural phenomena and should modify these only when they cease to be compatible with his own interpretations of his environment.

(d) frequently state alternative explanations for an observed phenomenon.

(e) identify "tentativeness" as an important characteristic of scientific knowledge.

Confluent Education

Immediately one notices that the previously identified goals and objectives relate to the cognitive area as well as to the affective. This is what is termed confluent education:

> Confluent education is the term for the integration or flowing together of the affective and cognitive elements in individual and group learning - sometimes called humanistic or psychological education (1:i).

Two psychological models deal separately with the two aspects of confluent education. The cognitive-development model of Piaget deals mainly with cognition although some research has been done on the moral development of children (10). The authors of the yearbook chapter present very clearly within the limits of the space allotted the ideas and implications of Piaget's research.

The psychological model that places a great interest in the affect is called perceptual psychology, humanistic psychology, third-force psychology or, as Maslow stated (5:34), someday it will just be called psychology. Its principal goal is to help an individual become the best human being that he is capable of becoming (6:186). Its principal thesis for learning is:

> Any information will have an effect upon an individual's behavior only to the degree to which he has discovered the personal meaning of that information for him (2:41).

Or, stated differently by Rogers (11:162) the thesis becomes:

> . . . self initiated learning which involves the whole person of the learner's feelings as well as intellect is the most lasting and pervasive.

Discussion of the Position Paper

The authors of the Yearbook chapter acknowledge the importance of dealing with the affect. Indeed, they state:

> One of the major factors of classroom environment is the affective climate. Most of the interpreters of Piagetian theory into science education programs have focused solely on the cognitive aspects of his theory, since that is the area which has clearly been delineated. However, the affective factors have not been taken into account. Piaget himself states that the cognitive and affective aspect of behavior are "inseparable and complementary" . . . Thus when we apply Piagetian tasks blindly as a means of assessing cognitive level we may very well be misled because of emotional factors which interfere with performance. A further implication of the importance of affective factors is the necessity of making the classroom a safe place for a child to risk making mistakes, to create an environment which is accepting of the child (p. 62) [emphasis mine].

I am impressed with how Rogerian the above statement reads, yet under the discussion of the student directed--humanistic--Rogerian psychology the authors state:

> Furthermore, significant, meaningful, self-initiated learning can be achieved or realized in an elementary school class, as described elsewhere (11:11-27). However, this cannot occur in the traditional, conservative, rigid, bureaucratic schools that one usually finds in America. Nor is this the way to learn for every child. Not every child is inner-directed and self-motivating.

> Implicit in this approach . . . is the assumption that children will be able to seek and find all the materials and experiences necessary to promote intellectual growth. Some may; many will not.
>
> Taken to an extreme, one might wind up with a society without schooling--"a society in which learning is not separated from, but joined to a part of life" (p. 49).

The above three paragraphs are important because they outline the reasons for eliminating from further consideration the model offered by the third-force psychologists. The ideas expressed or implied in these paragraphs warrant careful study since the chapter authors make a strong appeal for affective consideration later in their paper. It is my view that in order to arrive at a confluent education for the child, then the ideas of the humanistic psychologists must be blended with the cognitive development model of Piaget. Indeed, I see no real issue to debate between the two models since they focus on different (yet inseparable) aspects of the human mind.

> . . . However, this cannot occur in the traditional, conservative, rigid, bureaucratic schools that one usually finds in America (p. 49).

An implication of the above statement is that radical change in schools and teachers would be necessary to promote harmony between Rogerian thought and classroom practice. I certainly agree that this is the case. However, if harmony is going to take place between Piagetian theory and classroom techniques, then I submit that the same radical change in teachers' affect will have to be made. Let's get on with the job of facilitating that change in consciousness by synthesizing the ideas of two powerful schools of thought rather than the concentrating on one.

> . . . Nor is this the way to learn for every child. Not every child is inner-directed and self-motivating . . . (p. 49).

Research by Rogers (11) and Kagen (4) suggests strongly that this is not true, especially for the young child. However, I further believe that the above statement is inconsistent with the ideas of Piaget. The concepts of the functional invariants of assimilation and accommodation were invented by Piaget. These are internal processes which are necessary for cognitive development. These are psychological drives to restructure or use cognitive schema. Flavell writes:

> The problem in question here is the following. What prompts the subject--infant, child, or adult--to engage in cognitive activities vis-a-vis the environment? . . . Piaget does not deny the role of of bodily needs and their derivatives but maintains that the fundamental motive governing intellectual

> endeavor, the really necessary and sufficient one, is . . . an intrinsic need for cognitive organs or structures once generated by functioning, to perpetuate themselves by more functioning. . . . For Piaget, then, the need to cognize is not fundamentally an extrinsic motive. . . . The need is an intrinsic almost, defining property of assimilatory activity itself; . . . (3:78-79).

Piaget then calls the need to learn assimilation or accommodation. The humanistic psychologist simply calls it the need to know. Again, the ideas about the nature of the learner generated by the study of cognitive development are compatible with and supported by the ideas generated by the study of the affect.

Very rarely will one find in a typical class of thirty children more than a few children who have a self-perceived need to know what the teacher is trying to teach at the instant it is being taught. This leads to a great teachers' lounge myth of: "These kids don't want to learn!" Unfortunately the teacher's feelings of frustration often causes the word anything to be added to the end of the sentence. The untruth of this statement is as obvious to me as its truth is to the frustrated teacher. I tend to react strongly whenever I hear it or see it in print.

> . . . Implicit in this approach . . . is the assumption that children will be able to seek and find all the materials and experiences necessary to promote intellectual growth. Some may; many will not. . . . (p. 49).

It is implied by the above statement that the facilitator might abandon a child to his own devices or might withhold teacher structure from a child with an emotional need for such structure. Rogers (11:23) writes of Barbara Shiel's "experiment" as a sixth grade teacher attempting to establish a self-directed learning environment:

> She decides when her new program is not working as she wished. She decides the two classes, the self-directed and the teacher-directed, are necessary . . . By being open to the evidence in the situation . . . and basing her judgments on the evidence, she keeps herself flexible . . . and takes appropriate steps.

It has been my experience (and this experience is supported by research of Matthews, et al., 8) that when one has adequately designed science activities, few children experience an emotional need for teacher imposed structure.

An additional observation might be made regarding this point. Consider the few opportunities available for a child to engage in meaningful experiences in a "traditional" classroom. Yet most people develop cognitively to the formal operational level. If one had a humanistic classroom that allowed social and cognitive freedom, how many more opportunities to learn would be available? What would the net effect of this enriched environment be for children?

> . . . Taken to the extreme, one might end up with a society without schooling . . . (p. 49).

If the job of education of our young could best be served by deschooling our society, then we have an obligation to do so. However, I see no real threat from this quarter. Much research would be necessary to supply the evidence that would be required to eliminate schools.

Learning Conditions and Goals - Building the Bridge

The chapter authors state:

> If we want to be able to understand why things happen in the classroom and to be able to explain what we are doing, with causal interpretations and causal explanations, then we have to look to psychology for some of the answers. . . . Yet we must not assume that research in psychology will supply the answers for science education. It is the science educators themselves who must translate the findings of basic research into practice (p. 51).

I certainly agree with the above statement. Research is needed to take the philosophical statements of a psychologist into the laboratory. The laboratory for science educators consists of a teacher, sets of instructional materials, a classroom, and learners. Research is desperately needed to study the effects of these variables on learning outcomes. Fortunately, at least one such study is under way.

Matthews, et al. (8) have described project LEO (Learning Environments and Outcomes) at Florida State University. A review of this research project is beyond the scope of this paper; however, the basic thrust of this research is to hold constant all variables other than the teacher's classroom behaviors. These behaviors were quantitatively defined via interaction analysis and two contrasting learning environments were established (both using only manipulative materials but no written materials). One condition was termed Student Structured Learning in Science (SSLS) and the other was termed Teacher Structured Learning in Science (TSLS). The behaviors appropriate to the SSLS classroom were generated by considering the ideas of both the humanistic psychologist and the cognitive development model as to appropriate behaviors believed to be compatible with the goals previous identified in this paper. The researchers report (9):

> The students in the nondirective pattern of teaching showed a greater tendency toward self-actualization in the science classroom while the

> dependency of the teacher structured students appeared to increase. TAB test data revealed further a significant difference in the student investigative skills in favor of the student structured students with the most dramatic difference appearing in the performance of the low ranking students.

Thus it seems to me, that a fruitful line of research has been established using the concepts of both the cognitive-development model and the third force psychologist's ideas.

Concluding Remarks and a Caveat

It should be pointed out that my reactions to the chapter are personal and are based upon a rather literal interpretation of the words contained there. I suspect that in a dialogue, the authors and I would find few major disagreements. My impression of the total paper is positive, but my major concern is over the reasoning used to eliminate the humanistic school of thought from additional consideration.

REFERENCES

1. Brown, G. I. Human Teaching for Human Learning. New York: Viking Press, 1971.

2. Combs, A. "Affective Education or None at All," Becoming a Better Elementary Science Teacher, R. Sund and R. Bybee (eds.). Columbus, Ohio: Charles E. Merrill, 1973.

3. Flavell, J. H. The Developmental Psychology of Jean Piaget. Princeton, N. J.: Van Nostrand, 1963.

4. Kagen, J. Understanding Children. New York: Harcourt Brace Jovanovich, 1971.

5. Maslow, A. "Some Basic Propositions of a Growth and Self-Actualization Psychology," Perceiving, Behaving, Becoming, A. Combs (ed.). Washington, D.C.: Association for Supervision and Curriculum Development, 1962.

6. Maslow, A. "Education, Art and Peak Experiences," Humanistic Frontiers in American Education, R. Fairfield (ed.). Englewood Cliffs, N. J.: Prentice Hall, 1971.

7. Matthews, C., D. Phillips and R. Good. Teacher's Guide to Student Structured Learning in Science. Dubuque, Iowa: W. C. Brown, 1971.

8. Matthews, C., _et al_. "A Five-Year Study of the Development and Implementation of Two Quantitatively Defined Teaching Strategies for Elementary and Secondary School Science." Symposium presented at the 47th annual meeting of the National Association of Research in Science Teaching, Chicago, April 17, 1974.

9. Matthews, C. and J. Shymansky. "A Comparative Laboratory Study of the Effects of Two Teaching Patterns on Certain Aspects of the Behavior of Students in Fifth Grade Science," _Journal of Research in Science Teaching_, 11:157-168, 1974.

10. Piaget, J. _The Moral Judgment of the Child_. New York: Harcourt Brace World, 1932.

11. Rogers, C. _Freedom to Learn_. Columbus, Ohio: Charles E. Merrill, 1969.

EDUCATORS AND SELF-ACTUALIZATION

Marjorie King
Jefferson Parrish School Board
Gretna, Louisiana 70053

Self-actualization, that innate predisposition toward wholeness, fulfillment and realization of potentialities, is common to all persons. Out of this predisposition comes motivation or that inner urge that moves persons to action. This tendency, in turn, leads to the formation of basic commitments.

A person's stance in life is determined by the things to which he is committed. Commitment involves the willingness to work diligently and make personal sacrifice for something in which one believes. As Hanna (16) points out, commitments can be to foolish, degrading, selfish and fanatic causes or they can be to worthy, ennobling, altruistic and meaningful causes. Without self-commitment to an idea, belief, cause or profession, there is very little effect the idea, cause, etc., will have on one's behavior. It seems logical to assume that a person who is truly committed to his profession will constantly strive to increase his competence in that profession. Rubin (26) states that

> The difference between routine teaching and inspired teaching depends to a large degree upon the teacher's own sense of motivation and commitment . . . The way a teacher perceives of himself and his role, his attitude toward education, his belief in the children he teaches and his basic commitment--all influence the quality of his work . . . (26:250-251).

In this writer's opinion all teachers could be placed somewhere on a continuum from high to low competency, commitment, motivation and self-actualization.

Phillips (23) categorizes public school teachers into five types:

1. The Innovator who sees the need for change and seeks to bring it about without antagonism.
2. The Conformist who goes along with whatever is current without making much effort to make significant contributions.
3. The Ritualist who has retired on the job repeating the same lessons year in and year out.
4. The Retreatist who wants to get out of teaching and is always seeking other employment.
5. The Rebel who is against the entire system but makes no suggestions or plans for modification.

To this list might be added the Incompetent, who, through the ineptness of the system, has managed to get tenure, automatically receives his paycheck for doing practically nothing in the classroom, and who does nothing to try to acquire the knowledge, skills and attitudes that would make him an effective teacher; and the Professional who is competent, motivated, and committed teacher with a clear vision of his mission of enabling students in the self-actualizing process, one of the goals of education.

Of course, it is evident that these labels apply not only to teachers but with some slight revisions to administrators, college professors, etc. It is also obvious that four of these types have very shallow commitments or narrow visions of their commitment to teaching or the educational profession and that the other categories represent the majority of educators who are committed to their profession.

This paper is an attempt to review some of the factors that influence commitments and to suggest things that might be done in preservice programs to foster a reduction in the number of less competent, committed and motivated educators and in in-service programs to enable further growth on the part of the present corps of educators.

Factors Influencing Commitments

Attitudes and values, like commitments, are the result of the experiences in our lives. They are not innate, inherent characteristics of the human species. They must be learned. They are learned in the family environment, in churches, in classrooms (K-college), and in daily encounters with colleagues, students and administrators. The commitment and subsequent behavior of educators within the complex educational organization can be attributed to an interplay of some of the factors mentioned in theories of human behavior. Behavior is a manifestation of those things to which one is committed.

The forces which shape teacher behavior, according to Fantini (12), are his training, the type of teaching-learning experiences he has had; the organization of the school; the exigencies of the curriculum; and the political forces and pressures within the educational bureaucracy.

Bogue (4) states that an individual's behavior in an organization is determined by: (1) management philosophy, values and assumptions about the nature of man and his work; (2) structure, the organizational pattern or bureaucratic structure; (3) group membership, the formal and informal groups that influence attitudes, commitments and behavior; (4) individual personality, individual orientation toward persons, persons and tasks or ideas and tasks.

In discussing human behavior, Durkheim (11) states that within each of us there exist two beings which are inseparable yet distinct. One is the "individual being " made up of all the mental states which apply to our personal lives. The other is the "social being" which is made up of the ideas, attitudes and practices which manifest the groups to which we belong, in other words, religious beliefs, moral beliefs and practices, national and occupational traditions. He contends the formation of this "social being" is the role of education.

Some authors attribute motives and behaviors to societal factors. To paraphrase the words of Max Weber (33) suggests

> . . . that in a free society the motives which induce people to work vary with . . . different social classes. . . . There is normally a graduated scale of motives by which men from different social classes are driven to work. When a man changes ranks, he switches from one set of motives to another.

Vernon (32) notes that there are differences in motivational tendencies between social classes in the importance attached to achievement, individual effort, the capacity to postpone immediate gratification for future success and the control of behavior by internal conscience.

In contrast to Weber, Thelen (30) states:

> It is obvious that as participation in the larger society has broadened, which means extending itself downward, the new participants have *kept hold of their own culture rather than adopt a new culture*. Elementary school teaching, like nursing, has been a major route to higher socioeconomic or class status. The child of blue-collar parents has, through education, become a teacher, a white-collar person. To become a teacher he went to one of the more inexpensive colleges, where he was taught the behaviors that constitute the role of teacher plus some supportive rationalizations from psychology and child development. . . . He became a teacher by learning to act *like one*; his practice teaching -- by all odds the most influential part of the program -- gave him that. He has, then, learned the *behaviors* of a middle-class occupation; but he has by no means internalized the way of life with its inner motives and the style out of which the teaching profession emerged. He can act like a teacher but, to be blunt about it, he does not think like one; nor does teaching as an occupation have the centrality in his life that teaching as a profession had in the life of its practitioners fifty years ago. Upward mobility has enriched the aspirant's behavioral repertory and vulgarized the profession (30:76).

This brings to mind the statement that it is easier to act your way into a new way of thinking than it is to think your way into a new way of acting. Of course, there are many who would dispute Thelen's view with the claim that there has been a general shift from "the American Way of Life," namely the Protestant work ethic, to, according to Mills (22:115), "an individualistic, sexual, hedonistic and pecuniary set of motives which are now dominant in many sections of twentieth century urban America." The gradual disappearance of the "typical teacher" would, in fact, reinforce Thelen's (30) conviction that the classroom should mirror the larger society. Today we have a pluralistic society and thus cannot expect all teachers to fit the stereotyped role of the teacher of fifty years ago as is implied in Thelen's statement.

Becker (3:131) views situational adjustment as a major process of personal development: "The person as he moves in and out of a variety of social situations, learns the requirements of continuing in each situation and of success in it." He compares this to learning adult roles, for example, learning to be a doctor, policeman, or teacher; learning the definitions of the statuses involved and the appropriate behavior with respect to them. The writer thinks this explains why some new young teachers have problems when they begin teaching. They try to play or act out the role of a teacher that they have heard about or experienced and at the same time be the person they really are. Harrison and Scriven (17) found that principals tend to give below average ratings to those teachers who were very openminded and whose educational attitudes were highly progressive, while above average ratings were given to teachers whose dogmatism and traditionalism were considerably greater. Such practice certainly can influence the commitment and subsequent behavior of idealistic teachers.

Thus, many times the situation determines the image of the role of a teacher. For example, in Russia there is a uniform system of education and a standard curriculum determined by the Communist Party of the Soviet Union (CPSU). Diversity is not seen as a source of strength but as a deviation and is subject to punishment. One teacher with whom this writer spoke stated that she had to follow a prescribed curriculum and that the only "innovation" was the individual personality and classroom manner of the teacher. Chabe (6) declares

> In reality, however, a Soviet citizen is trained or educated (within limits) by the Soviet state in order to serve the needs of the state. Soviet Communist education enhances the power and capabilities of the state and not the learner. . . . Soviet education is producing the controlled and submissive man who is dutiful, unquestioning, and fervently patriotic. This 'builder of a new and more perfect society' has discovered that the general design had been laid out before him by Party ideologists and planners. He must now pattern himself and his behavior to that design in order to become a successful 'builder' of that 'new and more perfect society.' To do otherwise would result in failure (6:279).

It is clear what the teacher's role must be in Russia.

Becker (3) also discusses the fact that some people resist situational adjustment.

> . . . Here we can find a corresponding weakness in the desire to remain in the situation or to do well in it, or a determination to remain in the situation only on one's terms or as long as one can get what one wants out of it. Many institutions have enough leeway built into them for a clever and determined operator to survive without adjustment (3:133).

This certainly would apply to Phillips' rebel, retreatist, ritualist, and the tenured incompetent.

In contrast to psychoanalytic and behavioristic orientations in motivation, Rogers (24) fosters the positive motive of self-actualization which is a directional, constructive tendency toward wholeness and fulfillment, toward the actualization of potentialities, and toward the maintenance and enhancement of the organism. This, he says, is an innate characteristic of all organisms. This tendency may express itself in the widest range of behaviors and in response to a wide variety of needs. This assumption would be necessary to explain Phillips' categories of teachers. Rogers accounts for the apparent contradiction of two conflicting motivational systems operating simultaneously within an individual. He sees this "rift as an incongruence between self-perceptions held by the individual and his organismic experiencing." The conflict is brought about by "distorted perceptions of self and experience which grew out of conditions of worth introjected from significant others." Thus, he sees this "rift" or "incongruence" as something learned, "a perverse channeling of some of the actualizing tendency into behaviors which do not actualize." He believes that "individuals are culturally conditioned, rewarded, reinforced for behaviors which are in fact perversions of the natural directions of the unitary actualizing tendency." Certainly this explanation, possibly along with some other reasons, would be needed to explain Phillips' five types of teachers. The rebel, the retreatist, the ritualist and the conformist result from a perversion of the actualizing tendency. Rogers asserts that since perversions are due to specific types of social learning, then the possibility exists for changing them.

Similarly, Combs, Avila and Purkey (10) use an "internal approach or frame of reference" in their study of human behavior. They are advocates of perceptual psychology which takes the position that a person's behavior is determined by his perception of himself and of the world in which he is involved. Reality for each individual is what it seems to him as the way things seem to him as the way things are and he behaves accordingly. Every man, it can be said, lives out of images or mental pictures which control his behavior. Combs (7) states that self-actualizing, fully functioning people see themselves as liked, wanted, acceptable, able, dignified, worthy; in other words, they have positive self-concepts.

For a number of years, this writer has held a view which is a combination of the Rogerian and perceptual psychologists' assumptions explaining the complex behavior of educators. The writer believes that highly committed and motivated educators have positive self-images, an expanded or broadened mindset of others and the world, and a creative response to life; thus, they are persons seeking self-actualization and fulfillment. The less committed ones have a less positive view of themselves, a reduced or narrowed mindset about others and the world and the victim-image responses to life; thus, they are unconsciously hampering the self-actualization processes. The most successful teachers are those who have a realistic and positive view of themselves and who capitalize on their strengths while trying to overcome some of their shortcomings. This is the message of the best seller, How To Be Your Own Best Friend, in which the authors stress that persons should not fail to compliment themselves when they have done a job well and that they should get out of the "negative hypnosis" syndrome of emphasizing the things which they cannot do. How often does one hear literally or implicitly, "I can't do it," "I'm no good at that," "I have no talent," or "I'm a failure?" These negative self-images which most often are misperceptions inhibit participation in activities which foster the self-actualizing processes.

Similarly, motivated, competent, and committed teachers respond creatively to life situations, say "yes" to life, see the gifts of each situation and decide what needs to be done to make the best of each situation. In short, they are persons of hope. On the other side are the persons who take hopeless stances to life and see themselves as victims of circumstances -- "I have such bad luck;" "I had an alcoholic father;" "I have such poor students and/or facilities." "I'm only one person;" "There are too many problems;" "If only there were more time and/or money;" "What can you expect under those circumstances?" This brings to mind the words of a popular song, "Life is what you make it and what you make it is up to you." A creative response to life implies activity on the part of the individual--the victim response, passivity.

Highly motivated and committed teachers usually also have an expanded or broadened view of themselves in relation to others and the world. Their image is not reduced to my world, my lifestyle, my classroom or my school but rather is extended to the world, our classroom, our school and the acceptance of different lifestyles. They respond positively to others, accepting them, trusting them and caring for them. They are not naive; only the naive person could say that nothing is wrong with the world. Neither are they cynical; the cynic claims that everything is rotten, the world is going down the drain. Instead they are hopeful, realizing the demands, obstacles and limitations of situations but yet seeing the great potential and possibilities in their situations. They commit themselves to openness, objectivity and the self-discipline needed to accomplish that which they decide needs to be done in their situation. Figure 1 capsulizes these thoughts on the formation of self-actualizing behaviors.

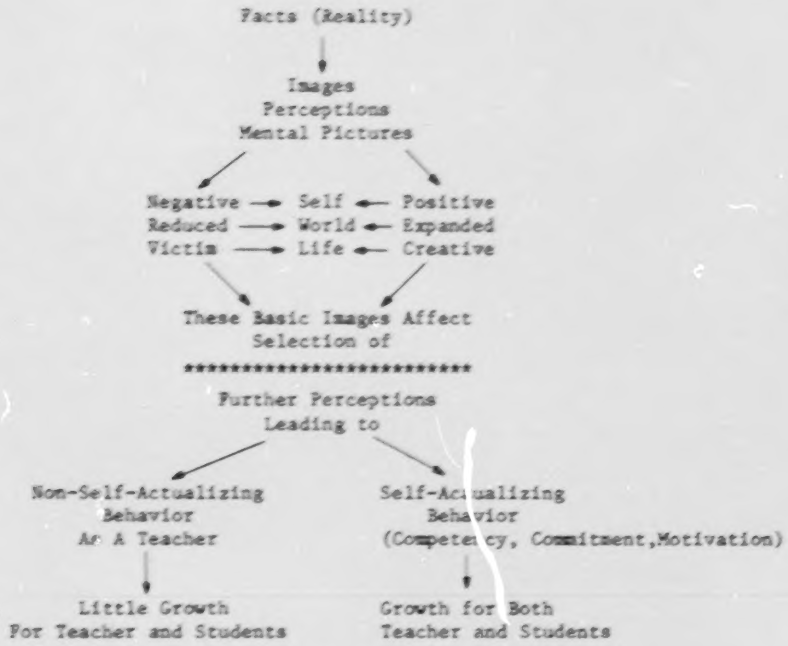


Figure 1. A Model of the Formation of Self-Actualizing Behavior

Argyris (2) found marked differences in "predispositions" of high skill and low skill employees. His data are summarized in Figure 2. This writer finds a marked degree of similarity between these predispositions and the differences she has observed between what she considers highly committed and motivated educators and those who are not so committed and motivated. What is disturbing about Argyris' study (of a particular manufacturing plant) is that he found that both high and low skill groups expressed approximately the same degree of self-actualization and that there was, on the part of both groups, a tremendous degree of apathy in regard to organizational goals and alienation towards others and towards themselves. Thus, they separated themselves psychologically (a) from the organization and (b) from human relationships. Hopefully, these kinds of data would not be found in studies of groups of educators since organizational goals and human relationships are essential ingredients in teaching-learning situations. However, Thelen (30) is concerned about the sense of detachment that is becoming increasingly characteristic of teachers, the loss of the missionary zeal that once motivated teachers and the growing impersonality of the teaching profession. He feels that teaching is becoming an "out-and-out" occupation and less of an "almost profession."

HIGH SKILL	LOW SKILL
1. Express a high sense of self-worth and self-regard related to their technological capabilities.	1. Express a very low sense of self-worth and self-regard.
2. Express need to be active.	2. Express need to be passive.
3. Express need to work with others.	3. Express need to be alone.
4. Express need for variety and challenge in their work world.	4. Express need for routine, nonchallenging work.
5. Express need to have some close friendships while at work.	5. Express desire not to make close friendships while at work.
6. Express need to produce quality work.	6. Express need to produce adequate quantitative work to make a fair day's pay.
7. Express almost no need to overemphasize the importance of material rewards.	7. Overemphasize the importance of material rewards.
8. Express need to learn more about other kinds of work within the same job family.	8. Express almost no need to learn other kinds of work.
9. Participate in activities outside their workplace judged by the researcher to be creative.	9. Participate in activities outside their workplace judged by researcher to be noncreative.

Figure 2. Some Differences Between High Skill and Low Skill Employees

Implications for Teacher Education

If one of the goals of education is to develop students into fully-functioning, self-directing, self-evolving and self-actualizing persons, then it is absolutely necessary that everything be done to insure that teachers and administrators also are themselves in the process of becoming fully-functioning, self-directing, self-evolving and self-actualizing persons. The implications for teacher education are obvious. Opportunities for authentic teacher growth and self-actualization need to be increased within the complex educational organization.

It seems logical that the three critical areas of teacher education that must be examined and changed where necessary are (1) pre-service programs, (2) "on-the-job" organizational conditions, and (3) in-service programs. Following is a list of recommendations which the writer thinks would result in a reduction in the number of less competent, committed and motivated educators entering the profession and an increase of opportunities for professional growth on the part of the present corps of educators. These recommendations call for a conscious, intentional, and determined collaborative effort on the part of university departments of education, school systems' departments of personnel and instruction, and individuals who are either preparing to become teachers or who are already teachers.

Pre-Service Programs

Preparatory programs do have a significant influence on the formation of competent, committed, motivated and self-actualizing educators. The two crucial components of pre-service education are the screening of the participants, both students and professors, and the cognitive, affective and psycho-motive elements of the education program.

Screening for Teacher Education. Those who teach future teachers need to be screened to ascertain if they, in fact, have the qualities of fully functioning, competent, committed self-actualized professionals. Woodson (34) suggests some criteria for screening university personnel but these do not fully cover the self-actualizing processes. Such criteria need to be developed and used by university departments of education.

Once the student completes the initial screening for admittance into the department of education, a continuous process of evaluation of performance should begin. As McClure (20) points out, however, valid measures of teacher competencies are yet to be defined and used in both pre-service and in-service education. Measures of teacher self-actualization are also yet to be developed and used during pre- and in-service education. From the beginning of the professional preparation, students should be involved with learners in classroom situations and their teaching performances in these situations continuously evaluated. Those who do not exhibit the necessary competencies should be counseled out of the teacher education program or provided remediation.

Teacher Education Program. Students need to acquire knowledge, skills, and an adequate grounding in the structure and methodology of the discipline(s) they will teach. The writer finds this especially true in science education. Science teachers need to experience true scientific research as part of their own preparation. More interdepartmental cooperation with the academic disciplines is required. Many students become certified with very nominal preparation in the disciplines they will teach.

Students need to participate in activities designed to (a) help them get to know themselves better as people, (b) help them acquire positive self images, (c) help them work with others in teams, and (d) help them get rid of victim images. They need to be exposed to a variety of options that can lead to self-actualization in the teaching profession. Anderson and De Vault (1) describe the developmental stages through which individuals move as they become teachers as (a) compliance with the instructor's methodology and value positions while they are in class, (b) identification with pre-service experience situations, and (c) internalization of values about teaching as teaching experience and position become secure. This implies that a variety of experiences at each stage would result in a broader value internalization.

Students need to acquire field experience very early in their teacher preparation program. They need to be involved with public school teachers and students from the wide spectrum of school types for as Phillips (23) states, potential teachers need to be prepared to teach all the children of all the public. Competent and committed public school personnel who are supportive and positive should be recruited to work in teacher education programs.

Students need to be given and take greater responsibility for their own professional development. Complementary to this is the need for greater individualization of programs, course work, and instruction; and the need for students to learn how to effectively evaluate their own performances and how to take steps to overcome any deficiencies.

Student teaching programs need to be implemented in such a way that all aspects of a teacher's job can be experienced. This should be full-time and last an entire semester. Taylor et al. (29) suggest a sequence for teacher preparation: (a) instructional assistant, (b) student teacher, and (c) paid intern. This, they say, would provide much more extensive and deeper experiences of what it means to be a teacher.

School System Organization Conditions. Organizational patterns, board policies and administrative behavior determine the quantity of competent, committed and motivated educators in a school system. As in the pre-service programs, effective screening is crucial. There must be a screening of teacher applicants, administrator applicants, counselor applicants, etc., to insure that competent and committed personnel are employed. Nothing erodes morale, motivation, and commitment more than hiring and promotion practices based not on competence but "who you know" or "which side of the political fence you are on."

On-the-job Experience. Education of the school administrators for self-actualization as educators is very important. In order that they contribute to the growth of teachers, they themselves must be constantly growing and becoming self-actualizing persons. It is assumed that administrators must also strive for the level of excellence in their own performances. They must serve as examples of persons in the process of self-actualization. They must also be willing to assess themselves, analyzing their strengths and weaknesses. Goldman (15) feels that most administrators, principals, and supervisors are not personally equipped or professionally prepared to exhibit leadership behaviors that are required of "perceptive generalists." Programs which focus on this need must be established in cooperative relationships between school systems and universities.

The initiation of changes to establish a climate for growth of self-evolving teachers must stem from the principal. Practices that would lead to greater openness and non-threatening climate which would facilitate growth toward self-actualization on the part of both principal and faculty members are: shared decision making, reinforcement and encouragement of individual faculty members, valuing and rewarding improved performances, making time and resources available for professional growth, equilibrium between freedom and control, and the encouragement of diversity rather than homogeneity in teaching style. Bogue (4) indicates that the

> . . . most productive relationships are those in which dependence, submissiveness, conformity and external evaluation give way to relationships which hold opportunity for the development of trust, independence of action, risk-taking and self-evaluation. These are essentials in providing organizational opportunity for individuals to achieve self-actualization (4:311).

Supervisors, consultants and coordinators must act as facilitators of professional growth for teachers. They should in their role of friend and encourager to teachers act as positive catalysts in the professional growth and self-actualizing process. Such experiences have constituted some of the richest personal rewards for this writer and are listed as a very important part of her personal job description. Lippit and Fox (18) have succinctly described this all important role.

> The supervisor should be a specialist in helping teachers diagnose their professional growth needs, designing activities that can contribute to meeting such needs, and arranging for such activities to take place. Beyond this, however, the supervisor is a key person in supporting the teacher in his efforts to initiate changes as a result of his learning. He provides interested and sympathetic follow-up, additional resources, suggestions for modification or adaptation of plans that are not working, and ideas regarding next steps (18:148).

The expectation of continual renewal and growth as a criteron for continued employment should be established. This should become a must for all professionals at all levels in the educational hierarchy. Details for the establishment and accountability of such programs need to be developed. The Southern Association of Schools and Colleges is now requiring a type of constant renewal for accreditation.

Standards of quality teaching must be ascertained and programs of cooperative teacher self-evaluation and school system evaluation developed. This implies that time, talent and resources of the school system should be made available for remedying any deficiencies, fostering further growth, etc.

In order that teachers experience more need fulfillment at higher levels of the Maslow (19) hierarchy, increased opportunities for professional advancement as classroom teachers must be provided. The writer has seen many excellent teachers leave the classroom for lack of such opportunities. In studying perceived need deficiencies of teachers, Trusty and Sergiovanni (31) found that the largest need deficiencies for all educators, categorized by professional role, have to do with esteem, autonomy and self-actualization. Their proposal, Figure 3, for restructuring teacher roles deserves much thought and consideration. This writer further suggests that (1) promotion up the hierarchy be based on demonstrated competence in the performances required of the role and (2) salaries in the top roles be comparable to those of administrators so that teachers would not feel it necessary to leave the classroom for increased salaries.

In-service Activities

Administrators must recognize the tremendous significance and need for effective teacher in-service education and thus assign it a high priority in the administration of the school system. Time for it must be built into the school calendar; scheduling for it cannot be done on an *ad hoc* basis. They must initiate the organizational structures and procedures which will promote teacher growth. They should see that teachers are involved in planning in-service activities. They should provide follow-up support.

Those responsible for in-service programs should be competent and committed professionals from within and without the school system. Some universities and school systems have begun such programs. Lippitt and Fox (18) propose the development of an inside-outside team composed of two or three persons from different levels from within the system and one or two experts from outside the system who can meet over an extended period of time to plan, design, and implement various in-service programs which will promote teacher growth toward self-actualization.

It must be recognized by all that as Galloway and Mulhern (14), Fantini (12) and Meade (21) declare, school is the real laboratory, setting, environment for professional growth to flourish. It does not occur only on college campuses nor does it emanate only from college professors. The potential for the implementation of one or more of the multiplicity of in-school or staff in-service activities must be explored.

The in-service activities must have a high degree of efficiency demonstrating that the majority of the participants can in fact perform the stated objectives demonstrating the acquisition of specific knowledge, skills, techniques, methods, attitudes and values.

And, just as pupil instruction must be individualized, so must professional development of teachers be personalized. Teachers vary markedly in their knowledge, teaching skills and their personal human

Position	Salary Index	Professional Competence Required	Teaching Assignment	Other Responsibilities	Professional Relationship	Involvement in Allocation of Resources
Intern	1.00	Formal education Potential teacher	Joint teaching Small teaching load	Work with students and teachers in extra-curricular activities	Works with typical students in cooperative teaching relations	Consulted
Fellow	1.75	Knowledgeable Skilled teacher	Joint teaching Individual teaching Medium teaching load	Supervises student extra-curricular activities	Works with a variety of students in cooperative teaching relationships	Participates
Associate	2.75	Content specialist Competent teacher	Individual teaching Differentiated teaching Maximum teaching load	Cooperatively works with teachers and parents on educational problems	Has maximum exposure to students in individual and cooperative teaching relationships	Participates and advises
Scholar	4.00	Creative, productive Outstanding professional	Differentiated teaching Collaborative teaching Medium teaching load Curriculum research and development	Identifies and maintains contact with profession at large through research, writing, and developmental activities	Collaborates in a variety of teaching experiences. Serves as educational clinician Develops experimental programs	Advises and allocates
OR						
Colleague	4.00	Collaborative, insightful Outstanding professional	Collaborative teaching Special teaching relationships Medium teaching load Human resource development	Cooperatively works with community, school administrators, and the board of education on broader educational issues	Functions as a coordinator of human resources, motivator, and assessment counselor	Allocates and helps secure

Figure 3. A Proposal for Restructuring Teacher Roles by Redefining the Teacher's Working Relationships (31:448)

relations. They need to begin and progress at their own level of sophistication in programs of professional growth.

Professional growth must be re-imaged as something the individual teacher does to and for himself rather than something imposed upon him by the system. Teacher organizations have a great responsibility to foster continual professional growth.

In-service activities must help teachers to acquire positive self-images and attitudes and help them to clarify personal perceptions of self, school and society. They must include experiences which extend the teachers' perception of their roles. They must allow teachers to examine current commitments and professed beliefs and the gaps between these and their current classroom practices. They should provide opportunities for teachers to identify existing perceived "barriers" or blocks that might lead to victim-image responses to situations.

In addition to providing personal growth, professional development must also be viewed in the context of group processes, team building and total staff development. It is well known that peer group influence on an individual's behavior is strong and that a teacher is not likely to aspire to continued professional growth if the aspirations are not shared by his colleagues. In the writer's experience, positive group processes can lead to the development of faculty trust which is basic for the sharing, cooperating, facilitating, enabling, etc., of colleagues that is characteristic of true professionals in the process of self-actualization.

Imperative

In this writer's experience, effective teamwork throughout the educational complex is not a common practice. The collaborative model suggested in these recommendations depends upon (1) teamwork and coordination, (2) commitment, and (3) competency of all concerned individuals in universities, school systems and professional organizations. The implementation of these recommendations for the preparation, service and continual growth of teachers can lead to the day when a greater majority of the educational corps will be composed of competent, committed, motivated and self-actualizing persons who are dedicated to facilitating the self-actualizing processes of their students.

REFERENCES

1. Anderson, Dan and M. DeVault. "Pre-service Education and the Developing Teacher," Educational Leadership, Vol. 24, No. 2, November, 1967.

2. Argyris, Chris. "Individual Actualization in Complex Organizations." In Administering Human Resources, Francis M. Trusty (ed.). Berkeley, California: McCutchan Publishing Corporation, 1971.

3. Becker, Howard. "Personal Change in Adult Life." School and Society. The School and Society Course Team. London: The Open University Press, 1971.

4. Bogue, E. G. "The Context of Organizational Behavior: A Conceptual Synthesis for the Educational Administrator." In Administering Human Resources, Francis Trusty (ed.). Berkeley, California: McCutchan Publishing Corporation, 1971.

5. Broudy, Harry. "Teacher Education: To Transmit? To Transform?" Educational Leadership, 28:695-697, April, 1971.

6. Chabe, Alexander. "Soviet Education Faces the 70's." Curriculum Concerns in a Revolutionary Era. Readings from Educational Leadership, Robert Leeper (ed.). Washington, D.C.: Association for Supervision and Curriculum Development, 1971.

7. Combs, Arthur. "Fostering Self-Direction." In The Helping Relationship Scorcebook, A. Avila, A. Combs and W. Purkey (eds.). Boston: Allyn and Bacon, 1971.

8. Combs, Arthur. "Some Basic Concepts in Perceptual Psychology." In The Helping Relationship Sourcebook, D. Avila, A. Combs, and W. Purkey (eds.). Boston: Allyn and Bacon, 1971.

9. Combs, Arthur. "What Can Man Become?" In The Helping Relationship Sourcebook, D. Avila, A. Combs, and W. Purkey (eds). Boston: Allyn and Bacon, 1971.

10. Combs, A., D. Avila and W. Purkey. Helping Relationships: Basic Concepts for the Helping Professions. Boston: Allyn and Bacon, 1971.

11. Durkheim, Emile. "Pedagogy and Sociology." School and Society. The School and Society Course Team. London: The Open University Press, 1971.

12. Fantini, Mario. "Teacher Training and Educational Reform." In Improving In-service Education, Louis Rubin (ed.). Boston: Allyn and Bacon, 1971.

13. Fischer, Louis. "In-service Education: An Immodest Proposal." In Improving In-service Education, Louis Rubin (ed.). Boston: Allyn and Bacon, 1971.

14. Galloway, C. and E. Mulhern. "Professional Development and Self-Renewal." In A School for Tomorrow, Jack Frymier (ed.). Berkeley, California: McCutchan Publishing Corporation, 1973.

15. Goldman, Harvey. "Educating the Administrators." Freedom, Bureaucracy and Schooling, Vernon F. Haubrich (ed.). Washington, D.C.: Association for Supervision and Curriculum Development Yearbook, 1971.

16. Hanna, L. "An Educational Imperative: Commitment to Change." In To Nurture Humaneness, M. Scobey and G. Graham (eds.). Washington, D.C.: Association for Supervision and Curriculum Development Yearbook, 1970.

17. Harrison, Jr. A. and E. Scriven. "Can You Be Liberal and Teach Too?" Peabody Journal of Education, May, 1970.

18. Lippitt, R. and R. Fox. "Development and Maintenance of Effective Classroom Learning." In Improving In-service Education, Louis Rubin (ed.). Boston: Allyn and Bacon, 1971.

19. Maslow, A. H. "A Theory of Human Motivation." In Administering Human Resources, Francis M. Trusty (ed.). Berkeley, California: McCutchan Publishing Corporation, 1971.

20. McClure, L. Morris. "Screening for Teacher Education," Educational Leadership, Vol. 24, No. 2, November, 1967.

21. Meade, Edward. "No Health in Us." In Improving In-service Education, Louis J. Rubin (ed.). Boston: Allyn and Bacon, 1971.

22. Mills, C. Wright. "Situated Actions and Vocabularies of Motive." School and Society. The School Course Team. London: The Open University Press, 1971.

23. Phillips, R. "Whose Children Shall We Teach." Curriculum Concerns in a Revolutionary Era. Readings from Educational Leadership, Robert Leeper (ed.). Washington, D.C.: Association for Supervision and Curriculum Development, 1971.

24. Rogers, Carl. "The Actualizing Tendency in Relation to 'Motives' and to Consciousness." In Milestones in Motivation: Contributions to the Psychology of Drive and Purpose, Wallace Russell (ed.). New York: Appleton-Century-Crofts, 1970.

25. Rogers, Carl. "The Interpersonal Relationship in the Facilitation of Learning." In The Helping Relationship Sourcebook, D. Avila, A. Combs and W. Purkey (eds.). Boston: Allyn and Bacon, 1971.

26 Rubin, Louis. "Authentic Teacher Growth," Educational Leadership, 28:701-703, April, 1971.

27. Rubin, Louis. "The Self-Evolving Teacher." In Improving In-service Education, Louis J. Rubin (ed.). Boston: Allyn and Bacon, 1971.

28. Rubin, Louis. "Teacher Growth in Perspective." In Improving In-service Education, Louis J. Rubin (ed.). Boston: Allyn and Bacon, 1971.

29. Taylor, B., P. Doyle and J. Link. "More Humane Teacher Education," Educational Leadership, 28:698-700, April, 1971.

30. Thelen, Herbert. "A Cultural Approach to In-service Teacher Training." In Improving In-service Education, Louis J. Rubin (ed.). Boston: Allyn and Bacon, 1971.

31. Trusty, F. and T. Sergiovanni. "Perceived Need Deficiencies of Teachers and Administrators: Proposal for Restructuring Teacher Roles." In Administering Human Resources, Francis Trusty (ed.). Berkeley, California: McCutchan Publishing Corporation, 1971.

32. Vernon, M. D. Human Motivation. Cambridge, England: Cambridge University Press, 1971.

33. Weber, Max. Protestant Ethic and the Spirit of Capitalism. New York: Scribner, 1930.

34. Woodson, Lauretta. "Screening for University Teaching," Educational Leadership, Vol. 24, No. 2, November, 1967.

WHY YOU'RE DOING WHAT YOU'RE DOING AND HOW!

A RESPONSE TO: "EDUCATORS AND SELF-ACTUALIZATION"

John P. Huntsberger
The University of Texas at Austin
Austin, Texas 78712

The purposes of "Educators and Self-Actualization" were clearly stated in the introductory paragraphs: to review factors that influenced commitments, to observe characteristics of highly committed teachers, and to suggest some things that might be done to foster reduction of the less committed, etc.

It is with the third purpose that this paper is concerned, because upon reading "Educators and Self-Actualization," one finds a plethora of "shoulds" and "musts " if not in fact at least implied. This is not uncommon in contemporary educational writing, but what is uncommon are indications as to how these "shoulds" and "musts" can be implemented in realistic educational settings. The focus of this response is that results occur when the "hows" are determined, explained, and put into action by a committed teacher.

Educators are responsible for knowing why they're doing what they're doing before educational action occurs. Were a teacher training institution and associated school system found that would attempt to implement the recommendations in the article, "Educators and Self-Actualization," the key to success would lie within the commitment of each individual comprising these institutions. This is no secret. But institutions and school systems do not have large populations who share exactly the same interpretations of stated purposes. Even in places where a small population rules absolutely, ideal accord doesn't occur. Less than perfect accord finds many of the "shoulds" and "musts " in varying degrees of development and successful implementation as in contemporary school systems and teacher-training programs. Where does that lead other than to circularity and apathy?

The way out of circularity and apathy is by explaining, demonstrating, and implementing the "hows" of some "shoulds" and "musts."

The teacher is a person in the classroom. Marshall and Burkman (2) recognized this necessary consideration when they wrote,

> Although the course-content improvement projects center on improvement in curriculum, in the "what" of learning . . . some attention must be paid to the "how" of learning, to the performance of the teacher in the classroom and laboratory (2:81-82).

The same authors continue to emphasize the importance of the teacher when they state:

> Although new kinds of textbooks, carefully contrived educational films, and the unique laboratory experiences are important elements in the science program, the science teacher still serves as the interpreter of these things to the student and is at the center of the teaching-learning situation. Only if his interpretation reflects the philosophy of the course developers is it reasonable to say that the student has "taken" the new course. If it differs sharply from the philosophy which guided the developers, one can say only that the student has enrolled for a given course - and perhaps received credit for it. He may well not have learned what the textbook and other aids to learning were intended to help him learn (2:81-82).

The conditions described by Ms. King in the section on in-service are perhaps the most important because they deal with the teacher as a person, especially where she reflects the necessity of acquiring positive self-images, attitudes, and extending teachers' perceptions of their roles. One of their roles is that of interacting with students rather than the extra-acting of what has been called the traditional teacher who dictated, demonstrated, and disciplined most of the time in a somewhat mechanical manner. As Travers and Dillon (4) have written,

> There are good reasons for doubting that most educational problems in the classroom are going to be solved by teachers learning simple rules that are applied by some simple mechanical process called stimulus generalization (4:8-9).

If interacting with students on a more humane basis is important, then the teacher desirous of this basis needs to know how it can occur. What follows are brief explanations of two ways in which successful implementation of working toward self-actualization have occurred.

Essence I (also referred to as ESSENCE-ESSENSE, Environmental Studies Kit, and E.S.) (1) is a set of materials designed to help a teacher develop positive self-images, attitudes, and extend his perception of his role. This is accomplished by providing information about their use, and, more relevant to this reaction, activities to be done and articles which help an individual focus on his educational philosophy and basic beliefs as to his purpose in the classroom. Essence I is a commitment to openness which fosters in students who practice and partake of it a sense of self-reliance and problem solving abilities. But a teacher cannot be only an interpreter of these materials for he must also partake and practice, else his position in the classroom will be that only of a performer. A performance is shallow and does not communicate to students that he cares about them and what they learn.

The Essence I materials are not a panacea in the sense that when you buy them and use them you will note an immediate dramatic change in yourself and your students, although it is certainly possible. Rather, those changes will occur over a period of time if one continually desires to change and commits himself to achieving this desire.

Institutions desirous of producing teachers skilled with some of the attitudes listed above might consider another mode, that of implementing a field-based science methods system. This is a method of having a university science methods class in school with students much like one would have if one were a certified teacher. What follows is a brief outline as to how this can be accomplished in an elementary methods class.

First, ask the principal of the school to which you are interested in going if you can meet with him and all the teachers at a faculty meeting. At that meeting, explain in clear, concise terminology what you intend doing to them, with them, and for them. Acceptance of your ideas has a much better chance if one begins in this manner.

Begin by asking, "Would one or two of you teachers volunteer to let me and my university students come into your class at a time convenient to you, for as long as you desire, within certain general time limits I'll explain in a minute, to teach science?" The response has been overwhelming for the past three years. I get more volunteers than one could possibly work with. Selecting which teacher to work with is, in fact, the most difficult decision. I usually ask the university students their desires. This helps me make a decision as to which teachers to utilize. If two separate science classes are to be chosen, which is often the case when I have twenty-four university students in the methods class, I use a primary and upper grade class. This gives the university students a chance to see the same model with two different age levels.

The time limit constraint alluded to above is one which must fit the university student's scheduled time in the school.

It is made clear to the classroom teachers that I will be totally responsible for their class; evaluation, discipline, and the like, during this time. They may leave the room if they wish or attend to whatever professional matters they desire. None of the participating teachers have done this, although I have been responsible in some cases for the evaluation to parents in both conferences and writing as to their child's science experiences.

The teaching usually begins with activities from the Elementary Science Study (ESS) and/or Essence I. I usually initiate the activities from ESS while the university students literally observe me and gradually work the university students into 1:1 - 1:2 teaching situations with the elementary students as the days pass. This continues until either a pre-set time limit is reached, the end of the unit is completed, or the university student in whose room we are working wishes to take over the entire class. When the latter occurs, the classroom teacher also provides assistance to the university student, and the other university people leave to begin in another classroom.

One can infer from what has been written that a commitment is required of all people concerned. Without a commitment, only a performance occurs, a performance in which the actors are not taken for "real" by the students and the content takes on the attributes of a "one-shot," "here-we-come, here-we-go" experience for the children.

Perhaps the teacher who has the attributes of clarity in organization, logical sequencing of materials, and presentation, coupled with variability and enthusiasm, *a la* Rosenshine and Furst (3), will not have to have the "hows" spelled out. Indeed, he will be able to create the environment which will answer children's questions. He will be a "people teacher."

REFERENCES

1. *Essence I*. Menlo Park, California: Addison-Wesley Publishing Company, Innovative Division, 1975.

2. Marshall, J. Stanley and Ernest Burkman. *Current Trends in Science Education*. New York: The Center for Applied Research in Education, Inc., 1966.

3. Rosenshine, B. and N. Furst. "Research on Teacher Performance Criteria." *Research on Teacher Education: A Symposium*, B. O. Smith (ed.). Englewood Cliffs, New Jersey: Prentice-Hall, 1971.

4. Travers, Robert M. W. and Jacqueline Dillon. *The Making of a Teacher*. New York: Macmillan Publishing Company, Inc., 1975.

PART III

TEACHER TRAINING

COLLABORATION IN TEACHER TRAINING

William Capie

and

David H. May
University of Georgia
Athens, Georgia 30602

"The university can't train teachers . . ." (1:54). "The education of teachers is one of those national problems that simply will not go away" (21:29). Thus began two articles in a recent special issue of the *Journal of Research and Development in Education*. Even the title of this issue, "Gaps in Teacher Education," suggests the presence of serious deficiencies in teacher education." Such criticisms are not new. As noted by Silberman (24:414), "Teacher education has been the subject of heated and frequently acrimonious debate since the early nineteenth century, and it has been the subject of recurrent investigation since the end of World War I." What is new are the identification of areas of need and the call for specific courses of action to rectify the problems. Criticisms are not restricted to teacher education alone, but to the educational enterprise in the largest sense.

Dissatisfaction with the current state of affairs in education is expressed in many and diverse ways, in both implicit and explicit criticisms. Professional schools decry their own inability to produce effective teachers; students insist on practical training and relevance; bond issues fail; popular writers "expose" the inadequacies of the system; and teachers are becoming more militant, demanding improved conditions, more materials and more money. All these pressures, and more, are lending force to the movement toward school accountability models. And, in a very special sense, schools of education are being held responsible for certain deficiencies in the system.

It may be fortunate that the press for change is occurring in a time of declining enrollments and teacher surpluses. Improving the quality of preservice programs might be easier when demand is small. For a time, at least, resources formerly devoted to producing the large numbers of graduates desperately needed to fill empty classrooms can be directed toward devising more effective training mechanisms.

The charge to teacher-training institutions is certainly more spirited now than ever before. Whereas we once prepared teachers, we now are struggling to prepare "good" teachers, or "better" teachers, or "effective" teachers, or even "competent" teachers. No one in the past advocated passing students who were "bad" teachers, let alone those who may have been incompetent. But the urgency to change, and to improve, is undeniable.

Specific criticism of existing programs takes many turns. McIntosh (15) cites the "lack of substance" in training programs.

Indeed the discipline of educational practice falls far behind other applied sciences. Educational psychology is "interesting" but with little apparent transfer value to prospective teachers. And, principles of curriculum planning and instructional design are almost unknown to undergraduates even after student teaching. Kalick (11) cites a

> . . . critical need to change the approaches both to teacher training and placement so that they [prospective teachers] will be more attuned to the realities of the public school classroom (11:261).

Haberman (10:133) carries this theme even further. In a very practical view he lists twenty-three reasons why universities cannot educate teachers. He articulates and questions a series of assumptions often made in teacher training. A few are pertinent here. Hopefully their fallacies are readily apparent. That the fallacies are not apparent may be symptomatic of the problems in teacher training.

3. Academic disciplines are related to lower school curriculum.
8. College instruction can be a modeling process of the way students teach in the lower schools.
9. The college environment supports a reward system that facilitates teacher education.
10. Colleges are accountable for their graduates' performance.
14. Colleges influence teachers' future performance more than the situations in which graduates subsequently operate.
18. College programs represent and offer the best of what is now known about teacher education.

Haberman's ideas are salient; his presentation is satirical; his summation ominous.

> Most critics of teacher education naively fail to recognize that any criticism of teacher education can be strengthened and amplified to include the higher education that functions as its parent and protector (10:133).

Further, Menges (16) has observed that few programs of professional education have been characterized by (1) clear underlying theory; (2) explicit, communicable objectives; (3) replicable procedures; and (4) follow-up validity studies. He maintains that the resultant ambiguity may have protected the profession from criticism. The protective pale no longer stands; demands for improvement abound.

In addition to the more general questions of relevance and substance of university course work, a problem exists in attempting to tailor programs to effectively deal with individual differences among students. Yvon (26) calls for a more individualized student experience. Rowe (20) supports this call by stating that, from a humanist viewpoint, traditional programs deprive students of meaningful decision-making opportunities. Attempts to meet individual needs are labeled as humanizing or personalizing the process.

Menges describes programs of teacher education as being either voluntary or manipulative.

> Little opportunity is available to students to control their own development and even less to their future clients to influence how professionals will "serve" them. . . . Programs designed to train professionals must be aimed at serving rather than manipulating the clientele (16:232).

In his view,voluntary programs are a desirable antithesis of the manipulative. Manipulative programs screen candidates to identify students most like present practitioners. A voluntary program is "a series of experiences or a collection of resources" to be used as students become what they want to be as professionals.

Ost and his colleagues at California State College state the following operational belief in their program proposal:

> Teaching should be personalized (i.e. the unique interests, aspirations, strengths and weaknesses of each learner should be accurately understood and taken into account in planning his instruction; and this should be done in a friendly, constructive, interested spirit) (18:2).

In the self-paced, partially individualized program at the University of Florida, attempts at personalization proceed on a contract basis.

> The student decides in each quarter what he will try to accomplish in that quarter. He makes his contract with the seminar leader and checks with this faculty member from time to time to let him know how he is progressing on his contract or whether the contract needs to be revised. Since the student may make some choices in each subject area, the responsibility for selecting a pattern of activities that avoids duplication and maximizes integration rests partly with the individual (20:371).

The "humanizing" forces in teacher education reform are highly critical of existing programs, but they are equally unhappy with the behavioristic competency-based teacher education (CBTE) models. Cornell (5) suggests that CBTE may be a last-ditch effort to maintain the status quo, especially in terms of who controls teacher education. The philosophical debates add to the fire of controversy but hinder effective change.

An area that appears to be of particular concern is determining when prospective teachers should be introduced into the classroom and the duration of the experience. Kalick (11) states:

> A teacher-training program can be truly effective only if a substantial portion of the educational sequence is devoted to the prospective teacher in the public school classroom (11:261).

The basic training model has remained unchanged over decades of practice. The stereotypic student teaching practicum is the capstone of the training program. Initially, prospective teachers spend several terms becoming well-grounded in academic areas. They then enter a somewhat briefer period of professional studies. One, two, or as many as fifteen courses in educational theory and methods now hopefully provide a foundation of knowledge about how to teach. "Knowing how to teach," the students are sent into student teaching to practice all they know.

Criticism of teacher education seems to focus in three areas: (1) lack of substance; (2) failure to individualize; and (3) lack of practical elements. Additional, early field-experiences have been proposed as a solution to these problems.

Incorporating more early field-experiences into teacher training programs may force the university to abdicate some of its traditional responsibilities and powers. If this occurs it could be perhaps the most significant change in teacher education since the establishment of normal schools more than a century ago.

Broadening the Base of Teacher Training

It is difficult to identify the locus of control of present teacher training programs. Potentially, control could rest with teacher training institutions, the State Departments of Education, professional teacher organizations, the public schools themselves, or with consumer advocacy groups. Expanded involvement in teacher education has two distinct facets. First, a broader community is involved in making decisions about teacher education. Second, the nature and the site of training are changing. Both changes reflect the concern that "no school system or university can do the job [teacher training] alone" (25:285). Commonly a joint university, public school, and community partnership is advocated (26). In practice the decision-making base is more diverse and representative in many new programs than in those of the past.

Professional associations can play a vital role in defining competence. Largely ignored by colleges planning preservice programs, the professional associations remain vigilant to protect the interests of their membership. The Washington Education Association, for instance, has an equal voice with teacher educators and school administrators in making recommendations on teacher education and certification and also on the matter of defining competency (5).

Community personnel can also contribute meaningfully if informed and involved whenever possible. Community involvement has been most effective in special situations where identifiable sub-cultures were concerned. For example, the inner-city efforts of Teacher Corps involved school-community liaisons. In a similar vein, students themselves are being consulted in planning their own programs. Their involvement has taken various forms--from student representatives on CBTE governance committees to instruction based on student concerns, as in the Personalized Teacher Education Program at the University of Texas. While each of these groups plays a significant role in one or more preservice programs, the two key elements remain the university or college and the public schools.

The redefinition of the role of the public schools is the most exciting element of the current crusade to improve teacher training. Unlike parents, state departments, and professional organizations, who merely help define a program, the schools also are involved in the implementation. The march into the schools for preservice training has raised two key issues: "the locus for training and the control over teacher education programming" (15:18). These are quite different problems, and "one does not necessarily imply the other."

Cooperation between the university and public schools is not without potential problems, however. Haberman (10), in criticizing the assumption that colleges and schools can cooperate, likens them to

> . . . slow-witted, lumbering elephants circling each other for a century only to discover they are both males and incapable even of friendship (10:134).

He further doubts that:

> . . . personnel in schools and colleges can work together. As if working in mutually exclusive organizations and being reinforced by different reward systems were not enough, personality and value differences are quite common. Public school people regard college people as too theoretical and more concerned with analysis than solutions, not capable of working within legal structures, incapable of hard work during regularly scheduled business hours. College people perceive public school people as too conservative in accepting research or responding to great social problems; fearful of superiors; of lower intelligence, status, and education. Public school people evaluate themselves positively for advocating basic structural changes in lower schools. In truth, both groups are experts in maintaining their own organizations and espousing radical reforms in the other (10:134).

To provide a broad background, some advocate providing experiences with a variety of teaching models in many different teaching situations. Kalick, in supporting this view, notes that:

> Every effort should be made to place students in a variety of classrooms where they can observe the best possible teaching . . . in classrooms heterogeneously grouped, homogenously grouped, and with children from both middle and low socioeconomic backgrounds (11:262).

Attempts to provide this much experience would have students spend so much time traveling from grade to grade, school to school, and sub-culture to sub-culture that there would be no opportunity for a complete or satisfying experience anywhere. Because continuity of experience is also viewed as essential, one representative experience, one good experience, may have to suffice.

Besides providing professional education, a teacher-training system has an additional, vital, responsibility--that of evaluation. Mechanisms for evaluation may be established jointly with other agencies but the decisions are usually left to program operators. Certification usually accompanies and depends upon completion of an approved program, so formative and summative evaluations are, in effect, the mechanisms of certification. Attempts to establish mastery of teaching competencies as a basis for certification, such as in Texas, New York, and many other states, indicate that State Departments of Education are becoming increasingly involved in the process of defining teacher certification standards. Developing models to assess competency attainment is difficult and may still depend heavily upon evaluations performed by teacher training institutions.

Competency-based certification strongly implies a more practical, applied, program of teacher education, lending further weight to the calls for change in present procedures. As training becomes more practical, the responsibility of the schools increases. Providing the necessary training for teachers apparently requires some form of collaborative effort between colleges and the local school systems. Given the differing needs and goals of the two institutions, such cooperative efforts may be difficult to achieve. School personnel may carry far different needs and values than university personnel to any session designed to establish a cooperative, collaborative program. Certainly universities and schools have been listed among each others' severest critics. Yet, the number of field experiences, internships, practica, and cooperative programs continues to increase.

What tasks unite the system? Clearly the school does not lose any of its current responsibilities. The school exists to educate children and young adults. Concomitantly the university has the responsibility of providing instruction and practice for the prospective teachers. Whatever model is adopted must recognize and attempt to meld together these responsibilities into a mutually beneficial whole. Both schools and colleges must feel that collaboration results in better experiences for children, better prepared teachers, and perhaps staff improvements among both faculties.

The Nature of Collaborative Teacher Training Programs

Collaboration in teacher training implies that two or more agencies design and implement a training program. Typically the design function of such a program rests on a broader base than does implementation, which has become a shared responsibility of schools and colleges. Implementation includes instructing children and trainees, arranging practical experiences, evaluation and ultimately certification. The two institutions can interact in a multitude of ways, all of which may be called a clinical approach to teacher education. Such efforts represent an attempt to bridge the gap between theory and practice by providing for immediate application.

Otto and Smith (19) suggest that such programs be a joint enterprise involving the training institution and public schools. This outlook is in marked contrast to the laboratory school concept where a university manages a school for a select student body. In effect, local schools, staffed by classroom teachers, are becoming part of training teams. Similarly trainers and trainees also become part of the school community. But they must stay sufficiently detached to observe and analyze instruction.

Collaborative models vary widely with the unique combinations of institutions. In Detroit, for example, the school system has formed a consortium arrangement with 12 colleges and universities. Various preservice experiences, including student teaching, are negotiated through the consortium (25). The University of Illinois, Chicago Circle, has initiated a plan, dubbed CPUTE, where "the university extends into the community and the schools; the community, in turn, has access to the schools and the university" (17:474).

The University of Wisconsin-Milwaukee has initiated a series of interesting collaborative efforts. Richard Davis (6) reports . . .

> We have begun restructuring teacher education with the idea that it would be useful to involve in our programs many more people than the faculty of the School of Education. . . . At the moment, for instance, we are involved in a dozen programs which share decision-making responsibilities with the Milwaukee public school system. . . . Joint department meetings are held, bringing together university faculty and public school supervisory staff. . . . There is, furthermore, considerable crossover of teaching staff between the two institutions. . . . One staff member on the School of Education faculty serves full time as a liaison between schools and the public schools in the areas of mutual interest, such as curriculum and instruction. . . . Some

> programs, furthermore, have co-directors, one drawn from the school system. . . . Coordinating these is the Committee on Institutional Cooperation, which is composed of three from the public schools--two assistant superintendents and the director of research. . . . It meets biweekly to plan joint teacher education programs. . . . These supervisors also serve on committees within the School of Education. . . . Students of education make up the second group with which the School of Education shares its decisions. . . . Finally, we share decisions with the communities in which most of our graduates will be teaching. . . . (6:56).

In a study of existing or planned programs, three basic models of collaboration can be identified. In each, planning, instruction, field experiences, evaluation and certification responsibilities are shared but in a different fashion. Each is characterized by distinct teacher, professor and student roles, as well as differences in effect on existing programs. Historically, the first efforts at collaboration were outgrowths of the traditional student teaching programs which can be subsumed in the "replacement model."

The Replacement Model

In this model, student teaching remains the principle, and in many cases the only, opportunity for direct involvement of the prospective teacher in a classroom. Goals of such a student teaching experience are diverse. They may be stated in either general or specific terms, yet the end for college students appears to be that of replacing their cooperating teachers in the school instructional program. Such a characterization may appear crude, but an examination of student teaching programs as they are practiced lends credence to the inference. Student teachers have traditionally been isolated in schools, sometimes remote from peers and the training scene. Work in schools typically involves one quarter or one-half semester. The college supervisor may visit once every two weeks for an hour or for an afternoon. In such a system, little of practical value can be accomplished in so short a time. At best, problem students can be identified for remediation or other appropriate action. The majority of students who are getting by without serious problems receive a minimum of assistance from such visits. The college supervisor must hope that student teachers are so thoroughly trained, or indoctrinated, that they can carry on without meaningful interaction with their instructors or peers.

Perhaps the most significant responsibility of the university's representative under this model is that of selecting supervising teachers. Even this task may be taken over by a university bureaucrat, or school principal, who rewards senior teachers or those with advanced degrees. Such assignments can be critical since the supervising teacher may be faced with the task of completing the student teacher's training.

Under this model, the expectations of the university may be so unclear that supervising teachers do what comes naturally. That is, create a teacher in their own image. In other words, they groom a replacement. The student observes for a period and then systematically absorbs portions of the teacher's responsibilities until taking over the classroom completely. "Taking over" is viewed as the culmination of student teaching. And so we graduate teachers who change rather than function as change agents within the schools, and the system is perpetuated.

Under the replacement model it is almost as though two training programs exist. The student is obligated to complete the first, on campus, before entering the second. The relative importance of each is difficult to establish since there seems to be little crossover between the two. On campus, the major responsibility is that of passing exams. In the field, the student's responsibility is to "fit in." Little vertical articulation exists in such a program. Many university faculty members are sufficiently removed from the field so that real needs are not translated into university programs. Similarly, the university is so far removed from the "real world" of the classroom that students find it difficult to translate innovative ideas and techniques to it.

Efforts to overcome the recognized problems are being made. "Practicum schools" have been formed to facilitate adequate supervision of students (19:721). Centers with many student teachers each term avoid some of the difficulties inherent in the replacement model. University personnel, functioning as clinical professors, are assigned to a school. Through long-term relationships and repeated assignments the goals for student teaching become better understood by members of both institutions, if not necessarily by students. University supervisors spend more time with students since concentrated placements minimize travel requirements. In spite of these strengths in operating procedures, student teaching centers still operate within the replacement model. Training precedes and remains separated from practice. Practicum supervisors may still have partial and inaccurate conceptions of the training program, and campus-based trainers may be unable to relate to the ultimate practice and employment situations. This persistent gap has led colleges to investigate mechanisms for relating theory and practice more effectively. These studies have led to changes which have been incorporated into what can be called an "experimental" model.

The "Experimental" Model

A second generation of innovation in teacher education resulted from attempts to reinforce campus methods experiences with immediate application during field experiences in local schools. In this model university students are involved in experimental, or exploratory, activities with children prior to student teaching. Involvement in direct instruction is not always a requisite of the experimental model. University students may simply spend a few brief blocks of time in the school to observe realistic situations. The exploratory activities at Grand Valley State College are typical.

> The college student planning to be an elementary or middle school teacher is assigned to a school principal, who, in conference with the student, plans the most effective way for him to become involved with children at every grade level, kindergarten to twelve; and through participation, to become familiar with the services of the school administrator, nurse, librarian, psychologist, custodian, and other staff members (7:15).

Dyrli (8:461) observes that schools and colleges usually initiate observer or teacher aide arrangements "in spite of the fact that nothing very magical will occur through simply having a prospective teacher sit in the back of the classroom for a period of time." A majority of these programs appear to be based in elementary schools. Typically they grow to include occasional teaching. College instructors suggest that interns try out a strategy learned in the methods class. Reading instruction is frequently tied to such a model (19, 23), perhaps be-because it is such a pervasive part of elementary programs. Science, too, seems quite involved in experimental teaching efforts, perhaps because almost any science activity is consistent with the nearly nonexistent programs in many elementary schools. At the secondary levels, no one content area seems more involved than another.

Experimental programs are jointly coordinated. They must be, for the schools open their doors to large numbers of college people, both faculty and students. This type of collaborative program is usually characterized by university dominance. Initially students are sent to schools for university purposes. They go on a university schedule. Their responsibilities in the school are defined by the university. Students in such a program tend to have sporadic involvement in the school, pernaps two hours twice a week. During these two hours they attempt to fulfill requirements which might include administering three Piagetian tasks (to no specific end), teaching a discovery lesson to a small group, etc. The classroom teachers bend their programs to accommodate the needs of the college students. To many students, the school experiences are add-ons to the traditional campus program which remains essentially unchanged.

Under this model, evaluation remains primarily a university function. Teachers may evaluate student activities, but teacher evaluations usually are not considered in assigning grades at the university. Certification is not an issue in these programs since they are usually followed by student teaching where that decision is made.

What motivates schools to become involved in such programs? One reason may be the possibility of good learning experiences for children. Many teachers report that their children are "exposed" to so many new ideas and activities. Too, an additional adult can share responsibilities with teachers, particularly at the elementary level. Since many of the programs are related to single methods courses, teachers may anticipate assistance in a difficult or distasteful portion of their teaching day. Elementary teachers also seem to show a remarkable and commendable desire to participate in introducing new members into the profession.

Experimental programs are too numerous to completely survey. The field-supplemented methods courses at The University of Maryland are representative. In these courses, students make four visits to a school, each with a distinct purpose in helping preservice teachers "understand, to evaluate, and to apply the ideas discussed in . . . methods courses" (9:9).

Lawson and Thomas (12) in describing the beginnings of a program at Cleveland State University, identify the university and the administration as the key elements in program planning. Neither teachers nor students were represented in the conceptualizing process. In contrast, the Lyndon State College Exploratory Field Experience in Education appears to have been established with strong teacher input. It is a career choice designed for persons interested in entering education as a profession. "Public school personnel offer their classrooms as laboratories for the college courses and serve as consultants or team leaders" (13:3).

Evaluation of experimental programs is difficult because of their diversity. Perhaps the most valid criticisms would be their disruptive nature and lack of continuity. Such weakness may be a direct result of university domination of the model. Students are in-and-out of schools at irregular hours throughout the school day and the term. The nature and purpose of requests by university faculty and teachers are not well-understood by each other. The interfacing between the two institutions is usually left to a university coordinator. McIntosh (15:18) claims that the coordinator's relationship to the school is similar to that of the trainees: "a visitor, an outsider who knows neither the individual students taught by trainees nor the problems faced by the school." McIntosh asserts that the entire program is "parasitical to the school, making little, if any, contribution to its development and yet placing additional strains on its severely taxed resources!" Yet some value must accrue since experimental programs continue in various forms throughout the country. Attempts to strengthen positive aspects of the model, broaden the planning base, and lessen the points of friction may lead to formation of a "cooperative" model (15:18).

Cooperative Models

Cooperative models for training teachers may evolve from either replacement or experimental models. Or, they may be created from the foundation upward in an effort to restructure programs. In a true cooperative model the education of children and the education of professionals should be indistinguishable.

> A cohesive training community must be established; . . . one should think of this community as being the teacher, and one must recognize that learning in this mode of training is frequently the product of unplanned encounters and events (15:24).

Thus, a community of school personnel, university faculty and university students is charged with the responsibility of educating some of its own members as well as children.

The cooperative model retains the strengths of the experimental model but avoids its weaknesses. A university or college becomes affiliated with a public school to establish a training program. Typically, the training institution creates a faculty team which plans to work together with a group of students over a prolonged period. Such a plan enables faculty to know each other well and to complement each other in a team-teaching format. Also, faculty and students come to know each other. Some of the threat of the faculty can be removed and the needs of students can be better known and met. Teachers, too, become a real part of the training community when a close and continued relationship allows them to develop a mutual respect with their colleagues from the university.

A training team has stability so that students do not pass through to a new school each term. Instead, the student experiences a series of roles within the team, each encompassing greater responsibilities. Virtually from the beginning of training college students have public school responsibilities. They may be minor at first, perhaps best described as those of a teacher aide. Later, with more experience the student may be properly called a teaching assistant. Finally, the student becomes a professional. Such a progression is far different from replacement, since the student's goal is not to replace the teacher but to assume an equal responsibility on a team. Having an extended involvement in different classrooms, with different children and supervising teachers, the student can view, select, and test various teaching models. This opportunity is not usually available in replacement or experimental programs.

As students gain more experience, beginning students are introduced to replace them. At the elementary level a teaching team might include 100 children, three professionals and six student interns at various levels. Advanced interns would spend a great deal of time on instruction-related tasks. Beginners would spend less time in the school and litle time in direct instruction of children. The essential aspect of this arrangement in the cooperative model is that the interns are regular, integral members of the team from the outset. Peer learning and sharing of knowledge from intern to intern is another potential benefit of this model.

Under this model, university personnel plan their program with the advice of the school community so that the two systems mesh. Most of the experiences desired by university faculty can be incorporated into a school program with joint planning. An interesting benefit of this structure is that classroom teachers are in a position to alter college curriculum by prescribing experiences for groups of interns or individuals. At the same time they may provide instruction in their areas of particular expertise. Teachers may also call on the university specialists with formal and informal requests for assistance.

University faculty share evaluation and certification responsibilities with teachers as well as students. The diagnostic aspect of evaluation is essential to the cooperative model. As with student teaching the final evaluation is tantamount to certification. It does, however, tend to be somewhat less time-based than with student teaching and shared more equally among elements of the training community.

Few programs at present are completely cooperative, although many do have some of the essential elements. The elementary program at the University of Georgia moved into the replacement strategy with the establishment of student teaching centers in the late nineteen-sixties. A program following the experimental model was initiated shortly after that experience (3). A more nearly cooperative program is now in operation and its structure is still evolving (4). Three elementary teams operate independently. Each includes the faculties of two Clarke County Schools, full-time university coordinators, a team of university faculty on a part-time basis, and sixty to one hundred university students. Each team is governed by some form of a steering committee composed of administrators, students, teachers, and university faculty. As further evidence of the cooperative nature of this program, a teacher from the Clarke County Schools has been released to the university and serves as co-coordinator of one team for the 1975-76 academic year.

A similar type program is described by Maddox (14:19) as operated by the Kanawha County Teacher Education Center. He cites as the focus of their efforts, an "urgent need for classroom teachers to be involved in establishing and implementing teacher education programs." Six areas of cooperation exist in their program: (1) placement of interns; (2) selecting clinical supervisors; (3) designing instructional programs for teachers; (4) establishing guidelines for evaluating interns; (5) coordinating lab experiences; and (6) cooperative offering of special methods courses. Interestingly, in this program teachers are recruited on their willingness and ability to abdicate the central position and become involved with students as motivator, guide, advisor, consultant, planner and source of encouragement. Such a teacher cannot be replaced, but there is room for two co-equals! In such teacher training the supervising teacher has three functions: (1) diagnosing student needs and prescribing student experiences; (2) assisting the student throughout the practical portion of training; and (3) helping the students evaluate themselves to determine their success.

Wichita State University has implemented "A Field-Based Approach to Introductory Education Courses" (2). The College of Education, together with the Wichita Public Schools, designed a program that is completely field-based. The instructional teams are composed of both public school and university personnel. Both elementary and secondary schools are involved. The assigned school is the locus of all activity for a semester. A major thesis of the program is that teacher education programs should be designed cooperatively by practitioners and teacher educators. Each group is involved in planning and implementing instruction and in evaluation. Such efforts seem to best exemplify the strengths of the cooperative model.

Conclusions

The process of teacher education is undergoing change, although perhaps not quickly enough to satisfy the most persistent critics. Programs are being developed and tested which will reduce the irrelevancy of teacher training by providing a broad experiential base through a prolonged, planned involvement of prospective teachers in actual classrooms. Such programs imply collaboration and cooperation where the college or university delegates some of its authority to the public schools and accepts them as partners in the training of teachers.

Such a partnership must recognize that each participant has different goals and requirements, and that joint planning is necessary to avoid domination of one goal over the others. Given this diversity of goals, truly cooperative efforts appear difficult to establish. However, the potential benefits to be derived from such efforts, for all concerned, would appear to make the effort worthwhile. In a well-planned program, college students will learn in situations not usually found in traditional programs, At the same time children also receive the benefits of increased opportunities. If maximum benefits are to be derived, students, university faculty, and public school personnel, must all be involved in the program planning.

A cooperative model of teacher training appears to offer more to the improvement of education than either the replacement or experimental models, both of which are university planned and operated to university ends. Although reality training is a goal in all three, reality in the experimental model is limited. School and teaching is not a series of one hour "fly-throughs." And, reality in the replacement model is the reality of the supervising teacher. Such systems appear to allow little time for reflection or modification of reality.

The cooperative model appears to offer maximum benefits to the program, to the school, teachers and children, and to the interns themselves. The program is strengthened because the decision making base, from planning to evaluation, is broadened to include diverse elements. The goals are kept relevant to all concerned. New techniques introduced by university instructors are illustrated and practiced as a regular part of an ongoing instructional program. That way, innovations are adopted when appropriate rather than tried as an experimental assignment and then forgotten. The school is not exploited in such a situation. It can share the benfits of cooperation. Instead of a parade of visitors it has an expanded teaching team. Teachers are able to teach and children are able to learn in ways which would be impossible with restricted resources. The program becomes a model of differentiated activity and responsibility.

In the cooperative model, the biggest gains are made by the interns. They are responsible people in a real teaching community and teaching is a responsibility which must be experienced before it is learned. As members of teaching teams, interns grow into full teaching responsibility. It is not a precarved niche which will be temporarily vacated by the classroom teacher. Instead the community is saying, "Come, find a place; satisfy yourself; help us help you help others."

REFERENCES

Citations containg ED numbers are available from ERIC Document Reproduction Service, Computer Microfilm International Corporation, P.O. Box 190, Arlington, Virginia 22210.

1. Bakalis, Michael. "An Administrator's View of Teacher Education," Journal of Research and Development in Education, 7:54-59, Fall, 1973.

2. Burgess, P. "A Field-Based Approach to Introductory Education Courses," College of Education, Wichita State University, November, 1973.
   ED 085 379 13 p.

3. Capie, W. R. "A Modular Methods Course as a Portal School Component," Science Education, 57:71-75, 1972.

4. Capie, W. R. "The Fowler Drive CBTE Program at the University of Georgia," in CBE A Process for Change, H. L. Jones and G. Hall (eds.). Englewood Cliffs, New Jersey: Prentice Hall, 1975.

5. Cornell, William. "Professional Associations Play a Part in the Competency Movement," Educational Leadership, 31:350-354, 1974.

6. Davis, Richard. "Cooperative Education Program" of Teacher Education Yearbook, American Association of Colleges, 1970.

7. DeLong, Greta. "Toward More Meaningful Teacher Preparation," Journal of Teacher Education, 22:15-17, Spring, 1971.

8. Dyrli, Odvard Egil. "Involving Prospective Teachers With Children—A Workable Model," Journal of Teacher Education, 23:461-463, Winter, 1972.

9. Ganatt, W. N. and B. Davey. Pre-Student Teachers React to Field Supplemented Methods Courses.
   ED 084 241 14 p.

10. Haberman, M. L. "Twenty-three Reasons Universities Can't Train Teachers," Journal of Teacher Education, 22:133-140, 1971.

11. Kalick, P. M. "New Directions in Teacher Training and Placement," Journal of Teacher Education, 22:261-264, 1971.

12. Lawson, J. H. and W. F. Thomas. "The School and the University: Adversaries or Partners?" 1974.
ED 083 189 11 p.

13. Lyndon State College. Exploratory Field Experiences in Education. Lyndonville, Vermont; 1973.
ED 085 383 7 p.

14. Maddox, K. E. In West Virginia, It is Working. One Teacher Education Center in Action. Washington, D.C.: American Association of Colleges for Teacher Education, 1972.

15. McIntosh, R. Gordon. "The Clinical Approach to Teacher Education," Journal of Teacher Education, 22:18-24, Spring, 1971.

16. Menges, Robert J. "Professional Education: Changing the Locus of Control," The Educational Forum, 38:231-235, January, 1974.

17. Monroe, George E. and Harriet Talmage. "Cooperative Program in Urban Teacher Education," Journal of Teacher Education, 21:469-477, Winter, 1970.

18. Ost, D. H., et al. "Report of Task Force on Models for Teacher Education," Unpublished paper, California State College, Bakersfield, January, 1972.

19. Otto, Wayne and Richard J. Smith. "School-University Cooperation in the Preparation of Reading Teachers," Reading Teacher, 24:718-722, May, 1971.

20. Rowe, Mary Budd. "A Humanistic Intent: The Program of Preservice Elementary Education at the University of Florida," Science Education, 58:369-376, July-September, 1974.

21. Ryan, K. "The Unfinished Work of Teacher Education," Journal of Research and Development in Education, 7:29-38, 1973.

22. Scheffler, I. The Language of Education. Springfield, Illinois: Charles C. Thomas, 1960.

23. Shankman, Florence V. "Innovations in Teacher-Training for Inner-City Schools," Reading Teacher, 24:744-747, May, 1971.

24. Silberman, Charles. Crisis in the Classroom. New York: Vintage Publications, Division of Random House, 1971.

25. Stewart, C. E. and H. A. Hart. "Teacher Education in an Urban School System," Theory into Practice, 11:285-290, 1973.

26. Yvon, Bernard R. "Teacher Education: A Partnership," Kappa Delta Pi Record, 10:68-70, February, 1974.

COLLABORATION IN TEACHER TRAINING:

A REACTION

Bernard F. Gross
Rochester City School District
and
St. John Fisher College
Rochester, New York 14618

and

Virginia T. Gross
Fairport Central School District
Fairport, New York 14450

We wish to thank the authors of the paper entitled "Collaboration in Teacher Training" for a well-organized and representative sampling of the literature, for a general classification system for grouping models of teacher education, and for an outline of the basic strengths of "cooperative models" of teacher education. If this reaction is coherently developed, it is due largely to the logical structure of the original paper.

Introduction

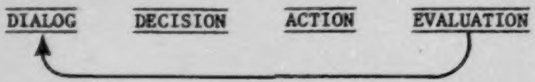
In the main, this reaction will support the "cooperative models" of teacher education as developed by the authors. However, with all the apparent strengths of "cooperative models" which are cited, some of the collaborative programs admittedly fall short of the mark. Inherent weaknesses, while not necessarily destroying programs, have at times made progress at the planning, approval, implementation, and evaluation stages very difficult (5, 6).

It is our plan to include in this reaction, therefore, some additional considerations which seem to be necessary for cooperating agencies to work together effectively. That there is a need to develop skills in handling the interactions of the management process seems to be supported by the recent marketing of simulation games relating to consortium decision making (2, 3). It is our experience that, in establishing "cooperative models" of teacher education, these considerations are often implied or overlooked, and for this reason many programs do not reach their full potential.

Our point of focus in these considerations, essentially, is the parity relationship involving the sharing of power, that is, the power to evaluate a candidate's qualifications and to recommend him or her for state certification.

A Management System

When college and school communities agree to develop a "cooperative model" of teacher education, they function as managers of a program to meet the certification needs of prospective teachers. The collaboration of these agencies, therefore, may be considered a form of management. One that seems to have been used effectively is the D/D/A/E system which was developed by the project entitled the Study of Educational Change and School Improvement (S.E.C.S.I.) (1).



This apparently simple management approach has many explicit strengths, perhaps the most important of which is role definition. When applied correctly, it clarifies the role of each cooperating agent or agency, a need expressed by Masoner (4) in his address to the International Reading Association. In this case, we can specify the "agents" or "agencies" as college, university, school district, teacher association, student association, and community group.

Dialog

The dialog of the D/D/A/E model can be truly "cooperative" and, therefore, most effective only when the role of each participating agency is one of sharing the power to effect change. Anything less than a real sharing of power places an agency in the position of merely providing data and/or a method for some other agency's decision. In the case of teacher preparation the "change" effected is the moving of graduates from the status of qualified student to that of certified teacher.

At the present time and in most instances this change is effected by the power to "recommend" and this power is held by one participating agency only—the college, which in turn has received it from the state. Two things seem to be necessary to alter this power position. First, the participating agencies must perceive their role clearly as that of decision makers. Otherwise, future steps in the D/D/A/E management process are weakened. Secondly, the college or university must relinquish its claim as sole proprieter of this power to recommend by acknowledging the qualifications of the other participating agencies to make effective recommendations as well.

Decision

Once the collaborating agencies, through dialog, come to view themselves as sharers in the decision-making process, the leadership and/or constituency of each agency can then provide an agent, whose task it is to work with the agents of the other agencies in developing and planning. Each agent understands his own status and that of the other agents to be representative of agencies sharing mutually in the power structure. Planning and developing is then begun without fear of future frustration from an improperly balanced power structure or an unresolved power struggle.

Because of basic understandings which have been worked out at the dialog level, each representative agent is free to collaborate with other agents and, as true representative of his agency, is empowered to submit an authorized "yes" or "no" to group proceedings. He has been made free to execute the second step in the management model, that of decision.

Action And Evaluation

Action and evaluation, the next steps of the model, emerge with a free flow from the careful construction of steps one and two.

As stated before, we agree with the authors of the original paper who claim that "cooperative models" overcome the weaknesses of the "replacement" and "experimental" models. Let it be said that we do find a strong affinity between the cited strengths of "cooperative" models as listed by the author and certain components of the D/D/A/E management model, specifically steps three and four, action and evaluation.

Critique

Few of the perceived strengths as listed by the authors however, can be categorized under steps one and two, the dialog and decision components of the model. Because of this and for reasons developed before, we suspect a potential, inherent weakness in the "cooperative models" described by the authors.

It is of interest that the authors seemed to sense the dilemma posed by the proprietorship of power on the part of the college in the "cooperative models."

> Such cooperative programs imply collaboration and cooperation where the college or university delegates some of its authority to the public schools and accepts them as partners in the training of teachers (p. 114).

It indeed appears that it is not enough for a program to merely imply "collaboration and cooperation" among cooperative agencies. A program must include the pesty and often painful step of dialog to insure and to specify explicitly the parameters of "collaboration and cooperation." Without the consensus reached through the dialog process, lethal gaps appear in the management system, which in turn short circuit the entire effort of cooperative models.

Recommendations

Let us now scrutinize the D/D/A/E model to determine more accurately its potential as a blueprint for a successful "cooperative model." Considering it as a bridge, it does span the entire route to be traveled toward the development of a manageable "model."

There are four basic strands in the structure of this bridge, each of which lends strength to and reinforces the whole:

1. the sharing of power between agencies
2. the delegation of power within agencies
3. the collection of data from the constituency of an agency
4. the gradual emergence of a collaborative decision to plan a "cooperative model" of teacher education.

These four strands or processes are specified in greater detail in diagram A.

Strands 1, 2, and 3, describe the dialog component. Strand 4 specifies the decision component. We may look at the dialog and decision components then as the cables providing the basic strength of the bridge. The action and evaluation components may be thought of as the bridge's superstructure. All four strands are placed together to provide a process which is both a system of management and a network of communication.

The combined effect of these four strands is the removal of all "implications" of shared power between the college community and the school community and the replacement of these implications by real and observable sharing of decision-making power. If all four strands are holding firmly, collaboration indeed exists and the destructive gaps have been bridged.

Flowchart

The following flowchart, applying the D/D/A/E model shows all the dynamics of a management system for collaborative planning. For conciseness in the flow chart, the word "power" is used. It has many meanings, two of which are the power to decide on changes in teacher education programs and the power to recommend changes in teacher education programs. The greater the shared decision-making power the more "cooperative" the model.

DIAGRAM A

The four basic strands or processes are specified below in greater detail.

1. The Sharing of Power Between Agencies:

Identify possessor power → Possessor of power shares decision-making power with cooperating agencies → Agency perceives that it has received decision-making power from the possessor

2. The Delegation of Power Within Agencies:

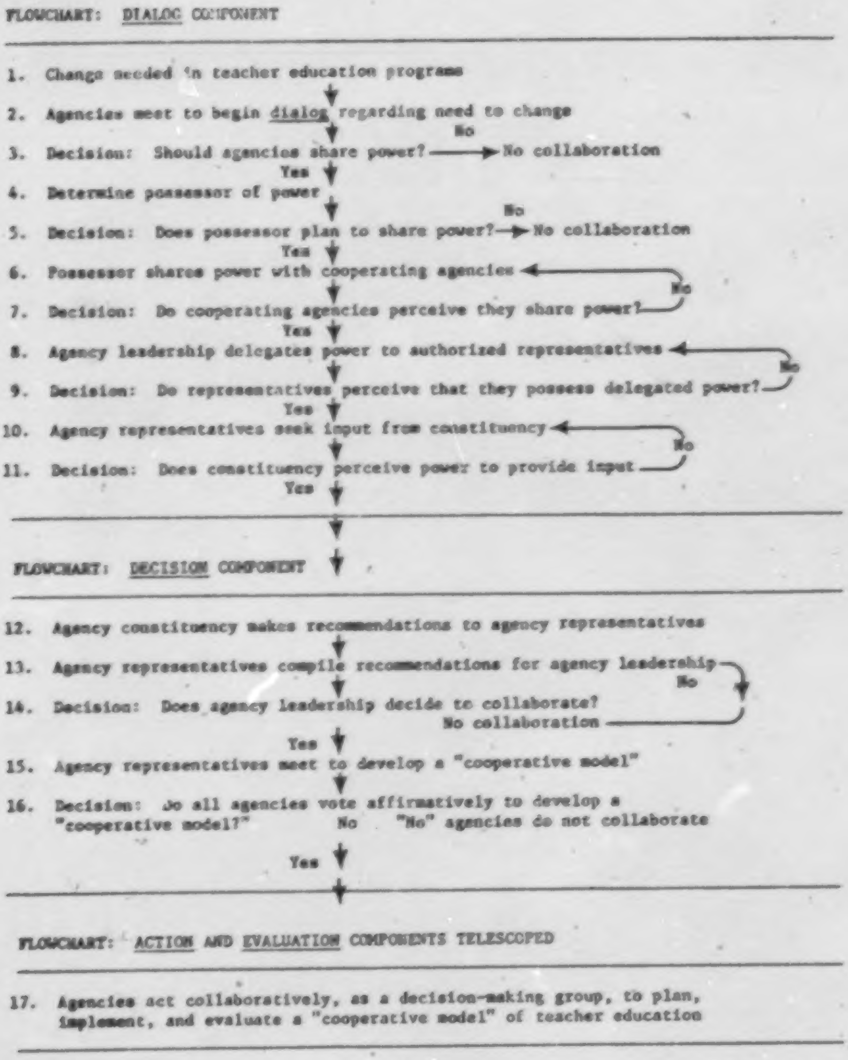
Agency leadership perceives it has received decision-making power from the possessor → Agency leadership delegates power to constituency and authorized representatives → Agency representatives perceive they have received power from agency leadership and constituency

3. The Collection of Data from the Constituency of an Agency:

Agency representatives perceive that they have received power from the agency leadership → Agency representatives seek recommendations from the constituency → Constituency perceives it has delegated power to make recommendations

4. The Gradual Emergence of a Collaborative Decision to Plan a "Cooperative Model" of Teacher Education:

Agency constituency makes recommendations to agency representatives → Agency representatives compile recommendations for agency → Agency leadership decides to collaborate with other agencies → All agencies decide to develop a "cooperative model"



FLOWCHART: DIALOG COMPONENT

1. Change needed in teacher education programs
2. Agencies meet to begin dialog regarding need to change
3. Decision: Should agencies share power? No → No collaboration (Yes ↓)
4. Determine possessor of power
5. Decision: Does possessor plan to share power? No → No collaboration (Yes ↓)
6. Possessor shares power with cooperating agencies
7. Decision: Do cooperating agencies perceive they share power? (No → 6; Yes ↓)
8. Agency leadership delegates power to authorized representatives
9. Decision: Do representatives perceive that they possess delegated power? (No → 8; Yes ↓)
10. Agency representatives seek input from constituency
11. Decision: Does constituency perceive power to provide input (No → 10; Yes ↓)

FLOWCHART: DECISION COMPONENT

12. Agency constituency makes recommendations to agency representatives
13. Agency representatives compile recommendations for agency leadership
14. Decision: Does agency leadership decide to collaborate? No → No collaboration (Yes ↓)
15. Agency representatives meet to develop a "cooperative model"
16. Decision: Do all agencies vote affirmatively to develop a "cooperative model?" No → "No" agencies do not collaborate (Yes ↓)

FLOWCHART: ACTION AND EVALUATION COMPONENTS TELESCOPED

17. Agencies act collaboratively, as a decision-making group, to plan, implement, and evaluate a "cooperative model" of teacher education

Summary

"Cooperative models" allow teacher educators to tap the resources of two communities, the university and the school district, and to offer the teacher-in-preparation the best of both. They allow the union of both theory and practice and of preservice and inservice education under the best of conditions. They enable the prospective teacher to be fully integrated into the operations and the staffing patterns of the school.

To establish a truly "cooperative model," however, certain considerations should be taken into account:

1. Cooperative development implies collaborative decision-making.
2. Collaborative decision-making is really a form of management.
3. An effective method of management decision-making and communication is the dialog/decision/action/evaluation system.
4. None of the steps in the D/D/A/E system can be taken for granted.
5. The strengths of "cooperative models" of teacher education cited in the paper fall within the action/evaluation components of the system.
6. The dialog/decision components cannot be implied. They must be conscientiously fostered by all cooperating agencies.

It would be sadly ironic if the strengths of the "cooperative models" were allowed to be weakened by flaws in the initial procedures. A well-planned and well-managed process of dialog and decision-making can make collaboration a successful venture in teacher education.

REFERENCES

1. Culver, C. M. and G. J. (eds.) The Power to Change: Issues for the Innovative Educator. New York: McGraw-Hill, 1973.

2. Ether, J. "Consortium Simulation." Teacher Education Development Service, State University of New York at Albany.

3. Kroner, F. and J. Durkin. "Teacher Education Center Workshop." Cleveland: Creative Learning Systems, 1972.

4. Masoner, P. H. "An Imperative: A National Policy for Teacher Education." Distinguished Leader's Address presented at the Sixteenth Annual Convention of the International Reading Association. Atlantic City, New Jersey, 1971.

5. Pomeroy, E. C. "Beyond the Upheaval." The Thirteenth Charles W. Hunt Lecture presented at the Twenty-Fourth Meeting of the American Association of Colleges for Teacher Education, Chicago, Illinois, 1972.

6. Ruchkin, J. P. "Teacher Centers: How Does One School - College Collaboration Work?" Journal of Teacher Education, 25:170-174, Summer, 1974.

STRATEGIES FOR INSERVICE TEACHER EDUCATION IN SCIENCE: PROBLEMS, PRACTICES AND A PROPOSAL

Jerry G. Horn
University of South Dakota
Vermillion, South Dakota 57069

Introduction

The need for inservice education for elementary school teachers is expressed by teachers, administrators, state departments of education, colleges and universities, curriculum writers and virtually every other interest group one can identify. Under the guise of inservice education, one often finds college courses, extension courses, workshops, seminars, consultation sessions and many other variations with unique attributes, such as scheduled time, compensation, college credits, salary increments, certification credits, etc.

The criticisms of past efforts are abundant and flow from various founts. Don Davies in his testimony to a Congressional subcommittee said, "In-service teacher training is the slum of American education--disadvantaged, proverty-stricken, neglected, psychologically isolated, whittled with exploitation and broken promises, and conflict" (3:38).

Reeler and Shapiro (16) have summarized the weaknesses existing among inservice programs from the available literature. These weaknesses as they have identified them are as follows:

1. They have restricted their focus to the remediation of teacher weaknesses, rather than capitalizing on current teacher strengths.
2. Their objectives have been irrelevant to the priority needs of teachers, students, and the community as each of these groups have perceived their needs.
3. No one has been held accountable for the success of inservice programs.
4. Inservice instructors have had limited recent clinical exposure.
5. Those who have initiated inservice programs have failed to cooperate with local universities and colleges in jointly planning the articulation of preservice with inservice instruction.
6. Inservice programs have not taken full advantage of modern communication media, thereby failing to reach a significant number of teachers.
7. Inservice programs have failed to offer adequate incentives to the tenured teacher.

While inservice education efforts are being criticized, there are portions of the country that are being provided very little if any inservice opportunities. This point may be brought into focus by reviewing statistical data in the 1970 United States Census Report. According to this report, the average population density in the United States was 57.5 persons per square mile within the 48 continental states, and population ranged from 3.4 persons per square mile in Wyoming to 953.1 persons per square mile in New Jersey. Twelve of these 48 states had a density of less than 25 persons per square mile. A listing of these states follows.

State	Population per square mile of land area
North Dakota	8.9
South Dakota	8.8
Nebraska	19.4
Montana	4.8
Idaho	8.6
Wyoming	3.4
Colorado	21.3
New Mexico	8.4
Arizona	15.6
Utah	12.9
Nevada	4.4
Oregon	21.7

With the exception of Oregon, all of these states are in two regional divisions, West North Central and the Mountain West.

To compound the problems related to servicing sparsely populated areas are the most severe weather conditions, the least available modes of public transportation, and few access routes to the public media.

School districts in the areas are comparatively small, and the self-contained classroom at the elementary school level is the usual organizational pattern. If one has six teachers for six elementary school grades, the feasibility of specialization or departmentalization within that building is questionable.

In 1970, the U. S. Census Report indicated that there were 1,082,280 elementary teachers. The sheer magnitude of this number, without even considering the aides and other paraprofessionals who function in elementary schools, demands creative models if inservice education is to be provided for elementary school educators. The problems related to sparse populations, small districts, many school districts, and large geographical areas may be placed in perspective by focusing on two states, Nebraska and South Dakota. Selected data are presented on the following page.

	Nebraska	South Dakota
Population[1]	1,483,493	665,507
Area (sq. miles)[1]	77,227	77,047
Density (land areas)[1] (population/square mile)	19.4	8.8
Elementary School Enrollment[2]	153,363	106,179
Number of Public School Districts[2]	299	195
Number of Public School El. Teachers[2]	9,443	5,381
Number of Public School Districts with 10 or fewer elementary teachers[2]	169	63

---

[1] 1970 Census Report
[2] 1973-74 School Year

One's first response might produce the suggestion that small school districts consolidate, but immediately the problem of distance and the retention of community identity is brought forth. Oftentimes these smaller communities' social structures center around the school. The closing of a local school has far greater implications than the mere turning of a key in a lock. It seems that those interested in providing inservice education for teachers in rural areas must take the social structure as it is and develop compatible programs and delivery systems.

Problem

The problem seems to center around three questions:

1. How can the quality of inservice education be improved?
2. How can inservice education be provided for teachers in sparsely populated areas and small school districts?
3. How can inservice education be provided for the large number of elementary school teachers?

Taking these questions under consideration, the crux of the problem to be addressed in this paper is to develop a proposal for providing effective science inservice education for elementary schools teachers in areas that are geographically isolated from large numbers of counterparts and resources. This proposal will be in the form of suggestions and criteria for inservice programs.

To refine the direction and target, the population is defined as those elementary school teachers that:

1. are assigned to self-contained K-6 classrooms or departmentalized K-6 science classrooms;
2. teach in small school districts (less than 30 elementary school teachers);
3. do not have a science supervisor/coordinator within the district;
4. are interested in improving the learning opportunities in science for their students.

The unique and/or some of the more common features of the target population are as follows:

1. Teachers have minimum background in science.
2. Resources for providing equipment and materials are limited.
3. Immediate access to qualified science educators is restricted.
4. Travel to colleges/universities is restricted because of lack of public transportation or excessive distance.
5. Consultant and/or inservice assistance in science is sought outside the local district.

At this point it seems imperative that a definition of inservice education be developed. There is no particular value in restricting the definition, if the objective is the same, and one assumes that to be the enhancement of the educational process. Therefore, for purposes of this paper, inservice education is defined as any program or activity undertaken by educational personnel that (1) is intended to enhance the educational process, (2) results in the improvement of the learning environment, and (3) occurs after initial certification into the profession.

State of the Practice

Inservice education or the activities and programs often termed as inservice seems to be an international concern. DeVault (7) writes of teacher centers as an international concept and specifically identifies teacher centers in England, Japan, and the United States. He says, "Curriculum development and inservice education are two needs which have fostered the creation of teacher centers in many countries" (7:37). Watkins (2) edited a collection of position papers that specifically address inservice from a variety of vantage points, government, local education agencies, colleges of education, polytechnical schools, universities and teachers. In his introductory remarks, Watkins speaks of inservice training.

> Inservice training was the subject of a national conference held in Leeds in July, 1972. It has often been remarked that seldom could so many people be in favour of a development of which we all know so little. Commitment to the further professional education of teachers constitutes an act of faith which must now be given some substance in the reality of experience (20:9).

Lord Boyle in writing the preface for this book about inservice training in England says, "It is safe to say that of all the recomendations contained in the James Report, none has received more widespread endorsement than the proposal for a massive increase of provision for inservice, or 'third cycle', training" (20:7).

The writer of this paper in his visits to South America (Peru, Argentina, and Brazil) in 1973 and Europe (France, Switzerland, Soviet Union and England) in 1974 has found considerable evidence of expressed need for inservice training in science and/or programs designed to provide such services for the elementary school teacher in these countries. With the possibility of translation and exportation of curricula such as the Elementary Science Study (ESS), Science Curriculum Improvement Study (SCIS) and others, and if other countries follow the same practice of providing inservice education concurrently with implementation, inservice science education or its equivalent will become even more prominent throughout the world.

The participation of the National Science Foundation (NSF) in and support of training programs for science teachers is widely known. Historically, NSF began operations on December 12, 1950, with an organizational meeting of the National Science Board (13) and since that time has supported many models for supplemental training of science teachers. According to Wailes (19), it was not until 1959 that NSF formally began participating in programs for teachers in elementary school science. Several staff papers written from the period of time 1957 through 1960 indicated that the foundation was very much interested and concerned but was unsure of the direction a program for elementary school teaching personnel should follow. Quoting Wailes, "The thoughts of the foundation could be summed up by a statement in a letter dated February 10, 1960, from Dr. Allen Waterman to Dr. James B. Conant: 'All in all, it seems to me that perhaps our greatest danger lies in going too fast and too far with preconceived notions about elementary science instruction before we have had the opportunity to think this over and confer with the experience of knowledgeable people.' It was for this reason that the foundation was moving into this area rather slowly" (19:3). Wailes continues by citing several programs that included a ten day science institute at Rutgers in 1957, a session for elementary school supervisors at Duke University in 1957 and 1958, a six week program for fifty elementary teachers in 1958 at the University of Rochester, and an inservice program for 29 Boulder, Colorado, elementary school teachers at the University of Colorado, among a few other isolated cases. One could probably best describe NSF's early programs in elementary science as rather sporadic and greatly dependent upon the nature of proposals from the most common sources, institutions of higher education. There is very little evidence of any systematic long-range planning either at the institutional, state, or national levels for approaching inservice education for elementary school teachers of science.

During the past 15 years at the University of South Dakota and many other similar institutions of higher education, various programs defined as inservice have been provided through the institutions of higher education with the financial support of the National Science Foundation. These programs have included summer institutes, academic year institutes, and various other activities for teachers of science. But looking at the content of the first institutes, one finds a heavy emphasis upon the content of the sciences. Specifically, it seems as though the institutes were designed to increase the subject matter knowledge of the participant teachers. Within the last decade, the National Science Foundation has funded a number of programs designed to develop curriculum in almost every comprehensible area of science at the high school and junior high school levels and also a corresponding number for the elementary school. Some of these curricula have been defined by certain critics as teacher proof. Within recent years, a different concept; curriculum-proof teachers, has been appearing in literature. In essence, I conclude that the evolution from teacher-proof curriculum to curriculum-proof teachers has placed a much greater emphasis on the expertise and the creativity of the individual teacher. There seems to be little evidence that institutions that provide preservice training for teachers of science, particularly at the elementary school level, have altered their curricula to the extent that their most recent graduates could assume this greater responsibility. Thus we seem to have a dilemma. On the one hand, we have educational experts proposing that teachers develop the curricula; on the other hand, institutions that prepare teachers seem to be giving little guidance or providing few programs for the expertise of curriculum development skills among their graduates.

By examining a list of project directors for the most recently funded National Science Foundation projects, it seems there has been a shift in the nature of the directors of the projects. The shift seems to be from college science teachers to those more specifically defined as science educators. Graduate programs around the country have prescribed that science educators be prepared both in the theory and processes of education as well as one or more of the sciences. Recently, the Association for the Education of Teachers in Science (1) developed guidelines for graduate programs in science education. Among these guidelines, it is suggested that science educators be competent in (1) the sciences, (2) the social context of education, (3) the design or development of curriculum, (4) the instructional process, (5) instructional evaluation, (6) research design, (7) administration, and (8) interpersonal skills. A careful review of the guidelines for the doctoral program in science education reveals that this is a very complete and well-rounded program for an individual interested in pursuing the provision of science education inservice programs in areas such as found in the target population of this paper. The competencies fully developed would permit an individual to assess the needs within a particular area, design a program, prescribe instructional content and staff, administer the program, and communicate with different groups involved in the program.

In a research study reported by Brimm and Tollett (2), several factors relative to teachers' feelings about inservice education were reported. This rather extensive study of 646 teachers in Tennessee included a questionnaire entitled "Teacher Attitude Toward Inservice

Education Inventory." The sampling procedures provided for proportional sampling, which included two percent of the teachers from each of the state's school districts. Usable returns were received from 65 percent of the sample. Teachers from each of the 147 school districts in the state were included. The purposes of this study were (a) to identify the types of inservice education currently in use throughout the state and (b) to ascertain teacher attitudes toward inservice education. Selected items from the data are described as they pertain to the particular topic at hand. The results of the items were reported as suggestions for improving inservice education. But what one can easily infer are specific weaknesses within the past inservice programs experienced by this group of teachers. As an example, 89 percent of the teachers agreed that they should have the opportunity to select the kind of inservice activities which they feel will strengthen their professional competence; 85 percent agreed that inservice programs should include special orientation activities for the new classroom teacher; inservice programs must include activities which allow for the different interests which exist among individual teachers, according to 96 percent of the sample; 93 percent indicated that teachers need to be involved in developing purposes, activities and methods of evaluation for inservice programs. A majority of teachers indicated that orientation activities for new classroom teachers were inadequate. Inadequate followup of instruction to determine the effects of inservice activities was cited since the inservice programs were scheduled as three-hour sessions at night. Most of the conclusions drawn from this study agreed with those of Reeler and Shapiro, including indications of irrelevancy in past programs.

The primary purpose should be to help the teacher upgrade his classroom performance. Teachers desire individualization of inservice education, and the teacher should have significant input into the formation of inservice programs and their particular administrative details, including content, time of day, release time, credit, etc. In the words of Brimm and Tollett, "Generally, this study substantiates the notion that inservice programs are poorly planned, inadequately executed, and lacking in proper evaluative procedures. Too often, inservice programs suffer more from a lack of direction than from a lack of financial support or time for execution" (16:524-525).

The reasons given for persons participating in inservice programs are many and varied. Among the usual reasons given are as follows: (1) new innovation being implemented in the classroom, (2) insecurity or lack of confidence in teaching assignment, (3) demands for recertification credits, (4) pressures from peers for improving learning environment, (5) increments available on the local salary schedule, (6) availability of course or inservice program in the district, (7) the opportunity to interact with educators, (8) the familiarity of identified instructor for the course, (9) reward systems other than salary within the district, (10) availability of using credits for advanced degrees.

Many of these reasons, if not all in some cases, have elements of invalidity for either making available the inservice program to such individuals or the time spent in the program by the participants. It would seem that there are greater needs among the one million plus elementary school teachers in the United States for participating in science programs than are given in the above list. Specifically, most elementary teachers are inadequately prepared by their own admission to teach elementary school science using the current curricular programs such as ESS, SCIS, S-APA, etc. I believe the inadequacies felt by these individuals go far beyond the lack of knowledge about the curricula and the content areas of biology, physics, chemistry, earth science, and mathematics. I believe inadequacies extend into the areas of basic methodology of teaching, understanding of concept and process development and a working philosophy of the nature of science. In recent years there has been a particularly large movement of school districts and Departments of Public Instruction or State Departments of Education to include as a part of their inservice programs the areas of interpersonal communications, human relations, affective education, and humanistic environments. The inclusion of these areas into inservice programs made available to teachers at the elementary school level is not to be considered a negative reaction from this writer's point of view, but rather a very important element in the total renewal and development of the teachers in the field. However, there are a limited number of days and a limited number of individuals that may be utilized for providing total inservice programs to faculties. This simply means that some of the areas, such as science and mathematics, for which the teachers are generally least prepared, are not being given due consideration.

The responsibility for providing inservice programs is at this time very unclear either by practice or by legal statutes. Private consulting agencies, departments of public instruction, colleges and universities, and local school districts all claim the responsibility for providing inservice.

This lack of a clear definition of responsibility, as I understand it, has resulted in a multitude of inservice programs that have simply overwhelmed the classroom teacher both in terms of number of available programs and the very wide diversity of topics, philosophies, etc. or the total lack of programs, or of programs that address real needs. Also, lack of assumed responsibility has prevented the availability of any inservice opportunities for others. Seldom do you find a well-organized plan or long-range goals for the provision of inservice education in the areas identified as those that have sparse populations with many small school districts. Rather, inservice education has primarily been planned on an annual basis and, all too often, on a daily basis. This has resulted in a patchwork program in response to a need. Others have suggested that inservice education provided remediation for deficiencies in preservice training. It is my conclusion that each of these is relatively ineffective in enhancing the learning environment of the child.

Horn (12) conducted a needs/interest study in the service area of the University of South Dakota. This area is defined as the state of South Dakota and an area within a 100 mile radius of the University, which would include portions of Iowa, Minnesota and Nebraska. This study was designed to determine: (1) the available population for inservice work, (2) the willingness/desire to collaborate with USD and/or contracted institutions in science education programs (inservice, consultant, meeting participant, etc.), (3) the extent of support (human, financial, and time) districts would be willing to provide for science education, and (4) the nature and extent of inservice provided within each district and the source(s) of its support. Selected data from this study are as follows:

1. 73 percent of the districts would provide release time for participation;
2. 33 percent would provide materials and equipment for implementation;
3. 23 percent would pay instructional costs (instructor's salary and expenses);
4. 65 percent would provide physical facilities.

While nearly all districts expressed some commitment, a common factor of agreement and/or extent of commitment was not evident.

Other data from this study allowed the rank ordering of physical arrangements for conducting inservice activities. They are as follows:

1. Workshops in the districts (five or fewer days);
2. Summer short courses (two weeks in length);
3. Consultants;
4. Extension or off-campus courses (fifteen three-hour meetings);
5. Conferences on science curricula (one - two days);
6. Workshops on the college campus (five or fewer days).

From a negative standpoint, one might conclude that the respondents to this questionnaire wanted to have programs that required the least amount of effort on their parts. As an example, the highest ranked service that could be provided to help improve their program would be workshops of five or fewer days in the district, and next would be summer short courses of a relatively short length of time. Since they are elementary teachers, in total they have had very little opportunity to participate in science institutes that were supported by the National Science Foundation and thus might not have an extensive knowledge of the various programs. However, some of these have been involved in college-cooperative programs supported by NSF, but few have received stipends and/or financial support of any kind.

Zoller and Watson (20), in writing about teacher training for the "Second Generation" science curricula, have utilized the thoughts of Cohen (4) when they say,

> Training programs, which concentrate on superficial nuts and bolts of specific XYZ programs with a few 'key-note' discussions related to inquiry-methods, problem-solving, open-ended experiments, who a

> scientist 'really is,' and so forth, should be abolished, since the prospective teacher will most probably remain what he is and keep doing what he has been doing (20:97).

They go on to urge that "teacher training activities must be consistent with what is desired for his future students: emphasis on action, on enquiry, on dealing with relevant problems, on interdisciplinary approach, and on decision-making" (20:98). Zoller and Watson offered the following suggestions for future preservice and inservice training programs.

1. Design and develop mini-units (parts of complete module) as a constant integral part of the program (independent study project, small group task force, etc.). Trial teaching of these mini-units (or parts) and implementation within schools (practicum) should follow. A design of an entire module for a local target class and actual (teaching) of selected parts should be their required final project.
2. Prospective teachers' involvement in innovative curriculum development should be a vital part of teacher training programs. It is considered to be probably the best place for constant development of instructional materials for new science and curriculum. An expected result: evolving of the curriculum in conjunction with teacher development.
3. Meetings and discussions with "model teachers" those already experienced teachers, who are considered to be successful in the implementation of innovative curricula followed by visits to the 'model teachers' classes--as part of the ongoing program.
4. Engage the candidate teachers in open ended investigations.
5. Organize debates on current issues.
6. Involvement of prospective teachers and staff in common social activities and projects. Seminars dealing with the problems evolved of these activities, or with societal-scientific (or technological) problems defined in terms of a particular target group should be sponsored regularly.
7. A foundation integrated-interdisciplinary science and technology course should be the umbrella course in science.
8. As preparation for evaluation, let the prospective teachers examine and evaluate existing curricula in accordance with the teachers' own criteria.
9. Prospective teachers should be confronted with situations that 'do not work as planned.'

10. An experienced teacher would be assigned to help and guide the beginning teachers during their first year or two of full-time teaching.
11. Consider science teaching a year round occupation with two months annually devoted to such things as curriculum development, inter and intra school meetings, reconditioning via inservice programs, searching for new sources and new ideas for improvements, and evaluation at the local school level.
12. A course in the philosophy and history of science would be (including case studies: Galileo, Fermi, Velikovsky) a mandatory course (20:99-100).

While these suggestions may be wholly acceptable in content and intention, the delivery system implied (independent study, small-group task forces, classroom visitation, and common social activities) is questionable in less densely populated areas and in small school districts, especially where there may be six or fewer elementary science teachers.

Inservice Models

There are many models of inservice and delivery systems, each probably developed more for convenience than for effectiveness. Guidelines from funding sources such as the National Science Foundation and the United States Office of Education often dictate the model and magnitude of inservice programs. It seems that the effectiveness of previous inservice programs is accepted, while little if any "hard" data exist to support such a position. Ruff (17) has gone so far as to say, "Why does all the research compiled on inservice education show that there is virtually no impact or change in teacher behavior as evidenced in the classroom instruction?" (17:507) Reeler and Shapiro (16), as they discussed the great change and innovation experienced by educational institutions in the past decade, developed this perception:

> As each of these innovations appeared on the educational scene, many schools looked to the traditional means for disseminating them to practicing teachers--summer or after-school workshops. Even progressive school systems soon found, however, that as soon as teachers became acquainted with the basic elements of a new concept, technique or method, one or several additional or significant innovations emerged. The inevitable conclusion is that the traditional models of inservice education are inadequate for the vital task of creating long-range continuous programs for teachers' inservice (16:54).

Lack of measurable objectives and testimonial evaluations has reduced the credibility of some inservice models that may have had potential for satisfying the criteria of an "effective model."

Creativity and innovations in inservice models have been hampered by restricted guidelines, backgrounds of proposal evaluators, unavailability of funds, delayed announcements of funding, solicitation of proposals from individuals and institutions and the desire by proposal writers to maintain a record of successful funding, among others. The demand for accountability at all levels may also have restricted high risk-takers and developed a conservative approach to program development.

A few of the more common approaches to inservice will be described with no attempt to establish value judgments.

Presession Inservice

Such a session is usually a one or two day period of time devoted to orientation, announcements, state-of-the-school address, presentation by invited specialists and/or classroom/building work before students begin the school year. This type of inservice is usually planned by the administration or a local committee and credit, either toward advanced degrees or salary increments, is not made available.

Inservice Day(s)

This is a period of usually less than the equivalent of five days provided during the school year in which a variety of activities may occur. These activities may include those previously mentioned for Presession Inservice and/or specialists developing particular topics. Oftentimes a number of sessions will be concurrently presented, and the individual teacher may choose those he wishes to attend. Consulttants from Departments of Public Instruction, colleges and universities, private consulting firms and publishing companies are common sources of expertise for such a program.

Inservice Courses

These are off-campus and/or extension courses provided through local colleges or universities on a regularly scheduled basis in a local school district. These courses are instructed by college personnel, or the services are contracted with a person that is not a member of the faculty through which the course is offered. The content of the course is parallel with the course provided as a campus offering, or it may be specially designed for this one offering under the heading of "workshop" or "improvement of instruction."

Inservice Workshops

These are programs offered for various periods of time, locales and specificity. State Departments of Education, colleges and universities among other interest groups, may provide these either free of charge or require registration fees ranging from the cost of refreshments and materials to a proportional cost of the total program which may be several hundred dollars per participant. College or salary credit is often negotiated by the participant with the institution(s) having some concern in the matter.

Inservice Projects

This is a collective term to include the inservice activities provided through externally funded projects such as NSF and USOE. In general, the inservice activities are provided without cost to the participant and credit is available for successful participation. The projects are usually designed to implement an innovation or curriculum if made available to one district and/or several districts involved in a common effort, or, if made available to individuals, the intent is to develop expertise to be exported to the individual's local district. The instruction is provided by the project's staff that may include college, elementary/secondary level personnel, and/or consultants with expertise in supporting areas of the total project.

Specific ESEA Title III federally funded projects in the area of teacher/staff development have been acclaimed for their creativity and success utilizing a grass roots approach to the improvement of education (14). Some of these projects are as follows:

-Creativity in the classroom
-Training Center for Open Space Schools
-Project Success Environment: An Approach to Community Education Improvement
-A County Training Program in Behavior Modification
-A Synthesis Approach to Teacher Self-Evaluation
-Staff Development in Creativity
-Inservice Training for Teachers of Natural Sciences

Other projects are cited by Reeler and Shapiro (16:71-105) as, in their opinion, attempts to overcome weaknesses (previously listed) in inservice education. Selected projects and the specific strength(s) they foster are listed below:

1. Project Bonus - maximizes teacher involvement and capitalizes on teacher strengths;
2. California Teacher Development Project - relevance of program to the needs of teachers;
3. T.T.T. Project - clinical approach to teacher training;
4. Teacher Training Modules - emphasizes the concept of an individualized approach to inservice education;
5. Florida School Staffing Study - emphasis is placed on the role of the teacher in training other teachers and working with interns;

6. River Rouge, Michigan Project - provides first-hand knowledge, practice and experience in certain systematic techniques for management of classroom behavior and instructional materials;
7. Philadelphia Teacher Center - provides teachers with materials and tools and conducts workshops.

A systems approach to inservice education and related areas is described by Purnell (15). She indicates, "The DEL MOD System is concerned with inducing changes in the permanent systems in the area of science education. It may utilize temporary systems to bring about change, but the objectives of the temporary systems are in response to needs identified by individuals for a particular set of circumstances in their permanent systems" (15:4).

The DEL MOD System is an intriguing idea and offers much for developing comprehensive inservice programs, as it provides for needs, process and product evaluation, leadership training, implementation and teacher training among others. However, one must consider that the project was funded at a relatively high level through the combined efforts of the National Science Foundation, the DuPont Company, the State of Delaware and private foundations. Also, one must consider that the State of Delaware has an area of 2,057 square miles and a population density of 276.5 persons per square mile of land area. Compare Delaware's density with Nevada which has an area of 110,540 square miles and a density of 4.4 persons per square mile of land area.

Eddy (8) addressed the important evaluative question of success of the British Teachers' Centres. He suggests, "While the Teachers' Centre idea in Britain seems to be very worthwhile, it still would appear that the idea might not be best transplanted *in toto* to North America" (8:511).

Other institutions under the general name of "teacher centers" have come to the attention of the public in recent years. Those in the United States have often been a response to the need for clinical experiences and/or a site for the demonstration of competencies by preservice teachers. James F. Collins (5) of Syracuse University has attempted to differentiate between teacher centers and teaching centers. He explains that a teacher education center or teaching center is a concept that embraces both preservice and inservice development while the teacher centers or teachers' center is focused on inservice teacher development and renewal. Eddy (8), writing about the implications for change relative to the Teachers' Centre idea in Britain, recommends that the following ideas might be well worth remembering.

1. Fundamental changes in education come only through those charged with the basic educational responsibility, that is, teachers.
2. Teachers are unlikely to change their ways because outside experts tell them to change.

3. Teachers will take reform seriously only when they are responsible for defining their own educational problems, delineating their own needs, and receiving help on their own terms (8:511).

The writer of this paper found a great deal of variety in the objectives and activities of British Teachers' Centres at Plymouth and Southampton in his visit to educational institutions in England in 1974. As one might expect, the specific interest and expertise of the Centres' wardens seemed to be one of the most influential factors in determining the direction of the unit.

In looking at various approaches, one finds elements that offer potential for addressing the unique needs for inservice education for the target population addressed in this paper. One thing seems very clear, and that is the need for long-range, systematic plans and commitments by all participating groups. This commitment must include financial and human resources as well as the belief that the provision for inservice education is the responsibility of the total profession, and continued self-development is the responsibility of all professional educators. However, designated individuals and/or groups must be charged with the responsibility for the development of essential components.

The proposed role of state education departments in inservice education may be projected from the results of a telephone survey in the fall of 1973. The study by Van Ryn and Van Ryn (18) sampled twenty-two states, "a good cross-section" in the words of the authors, and asked each respondent about the unit's role regarding inservice education in the next 3 to 5 years. The following kinds of activities and services were mentioned:

-Providing consultative and management services to help school districts in conducting staff assessment and developing inservice programs;
-Developing procedures, policies, and regulations that would allow inservice education experiences to be used for continuing a permanent certification;
-Facilitating the establishment of teacher education programs that would be responsive to preservice as well as inservice needs;
-Developing systems for providing more adequate fiscal support for inservice education programs throughout the state on a local or regional basis (18:1, 8).

The role of colleges and universities in inservice education activities is greatly dependent upon the perceived mission of the institution and, more particularly, on the interests and efforts of individual faculty members. A whole new breed of professionals, science educators, seems to have evolved out of the milieu of strifes between departments of education and departments of the various sciences. It is with this group, the science educators, which is relatively unique to North America, that the hope and burden of responsibility for inservice science education may rest. Their training and experience bridge the gap between educators and scientists, and their teaching experience in elementary and secondary schools provides the initial credibility with teachers of precollege students. Continuation of credibility and demonstrated confidence can best be judged by actions rather than by credentials.

A Proposed Inservice Model

The proposed model will include not only the systematic planning in terms of responsibility, financial resource, and instructional personnel, but it will also include the vehicular means to satisfy the demands of a relatively unique group of people, those in the areas described earlier. Interestingly enough, one can find the same kind of problems in almost every state in the United States and in almost every foreign country relative to the small number of teachers in large numbers of districts. Whereas in the city the problems might revolve around the numbers problem, and NSF programs have suggested that multipliers be built into programs in order to serve the large numbers of teachers, the population being addressed in this study needs multipliers, but it does not need multipliers specifically or only for large numbers of people. It also needs multipliers to solve the problems that are caused by geographic isolation, small school districts, and lack of an adequate number of science educators.

I propose an inservice model that has few elements that are unique, but the total composition, with the useful ideas and practices taken from the literature and mentioned in this paper, is unique for the target population, elementary school teachers of science in small districts (less than 30 elementary school teachers) and especially those in the less populated regions of the country with very little immediate access to acceptable inservice education and/or opportunities for professional development in science.

Educational institutions and agencies would organize as a regional center. The center would function as the nerve center, for evaluation/research, instruction, curriculum development and as a resource bank for a given area. The service area for each center would best be defined by the natural and man-made barriers hindering accessibility. For an example, a very large area with educational TV and no barriers such as moutain ranges, unbridged waterways, etc. might be more efficient than combining several isolated districts which are not limited to a common educational TV source.

An individual, prepared in much the same way that AETS has proposed in their guidelines for science education doctoral programs, would be appointed as director of the regional center. The director's job would be one of research and development as opposed to an administrative post. He/she would be responsible for:

1. initiating and conducting needs assessments;
2. designing long-range plans for systematically addressing the determined needs;
3. assisting participating districts in curriculum development;
4. assisting individuals from the participating districts by providing career counseling;
5. selecting and/or locally developing programs for addressing an identified need(s);
6. arranging for staff and facilities for activities in the center;
7. continuously monitoring all aspects of the regional center's operation through process and product evaluation;
8. developing a facility within the region that provides for a professional and curriculum library, workshop for materials and equipment development, media production, communications network, and professional consultation;
9. developing and submitting proposals to local, state and federal agencies and private foundations for external support for regional inservice programs;
10. administering the financial and personnel aspects of the center's operation.

The regional center should be equally supported by all participating districts, and other participating institutions and agencies should support the center on a negotiated basis with services rendered and benefits derived being considered. Each participating institution and agency would be represented on a coordinating committee that assists in determining policy and direction of the center's operation. Although the center's director would be employed by one of the districts, the salary and benefits would be shared equally by all participating districts so that all districts could expect expect equal attention from that person. The participating institutions of higher education may choose to extend professional rank to the director and contribute to his/her financial support.

The inservice programs provided through the center must be available to individuals and groups. I propose that a large collection of instructional modules that are competency-based and exportable to various settings be developed for utilization in the center. The modules would provide opportunities for one to develop knowledge, teaching methodology, and laboratory skills. Each center would identify needs and, based on an expressed priority, contract for the development of instructional modules on a well defined timeline. The modules would vary in length and an individual could select a series of modules that in total would be accepted as equivalent to a specified number of credit hours at colleges/universities and/or provide for recertification based on demonstrated competencies. The modules that are not locally developed would be contracted for from institutions of higher education and other agencies that place service as a high priority, provide professional staff for developmental activities, and have staff members that are experienced and competent in the specific area of concern.

The concept of one instructor teaching an inservice class on ESS to a group of elementary teachers must be abandoned. Time, size of area and small number of participants reduce the effectiveness of this practice as a viable alternative. Utilization of commercial, educational and/or closed circuit television would be a first step in providing dissemination pathways. Following dissemination, telephone communication via WATS lines and conference phones would permit followup and discussion. Elements of this suggestion for use of communication systems are being utilized to disseminate information on ESS, SCIS and S-APA in Project TAPE, an NSF supported program at the University of South Dakota. Demonstration and/or model lessons could be placed on video tape and distributed on an individual basis. Persons responsible for determining whether an individual had demonstrated competence in a particular area could utilize the same communications system provided for instruction.

The workshop area of the center to be developed for individuals or groups to produce media, curriculum, and equipment and materials could also be expanded to include a central location and distribution point for service equipment and materials, and for the maintenance of living materials for classroom utilization. The equipment, materials and living specimens could be distributed by van on a regularly scheduled basis throughout the center's area. An example of a maintenance and distribution system is operational at the Omaha Suburban Area Council of Schools Science Center (OSACS Science Center) at Gretna, Nebraska.

In conclusion, and as a challenge to action, one person or possibly one institution must initiate the action. Science educators at colleges and universities probably have the most experience in developing and conducting inservice programs; therefore, I challenge science educators to assume the leadership role in delivering needed inservice education to this target population. The need for inservice education is seemingly unquestioned, particularly in elementary school science and among the small districts of the less populated areas of the country. The first step may be the most difficult, and there is not one solution, but a systematic plan with well defined objectives, a realistic timeline and genuine long-term commitments specific to the target population will be a step in the right direction.

REFERENCES

1. Association for the Education of Teachers in Science. "Report of Committee on Revision of 'Guidelines for the Doctorate in Science Education,'" AETS Newsletter, 7:12, 1973.

2. Brimm, Jack L. and Daniel J. Tollett. "How Do Teachers Feel About In-Service Education?" Educational Leadership, 31:521-525, 1974.

3. Bush, Robert N. "Curriculum-Proof Teachers: Who Does What to Whom." Improving In-Service Education, Louis J. Rubin (ed.). Boston: Allyn and Bacon, Inc., 1971.

4. Cohen, R. D. "Problems of Retreading Science Teachers," Part II. Science Education, 56:417, 1972.

5. Collins, James F. "The Making of a Teaching Center," Journal of Teacher Education, 25:13-20, 1974.

6. Council of State Science Supervisors. Data Utilization: A Key to Improved Science Education. Richmond, Virginia: The Council of Science Supervisors, Inc., 1974.

7. DeVault, M. Vere. "Teacher Centers: An International Concept," Journal of Teacher Education, 25:37-39, 1974.

8. Eddy, Wesley P. "How Successful are the British Teachers' Centers?" Educational Leadership, 31:509-511, 1974.

9. Ernst, William. "What Makes A Workshop Jell?" Educational Leadership, 31:496-498, 1974.

10. Fox, Robert S. and Don A. Griffin. "A New Model for In-Service: When Clients and Resources Cooperate for Growth," Educational Leadership, 31:545-547, 1974.

11. Hart, Helen A. "Self-Renewal: A Model," Educational Leadership, 31:499-501, 1974.

12. Horn, Jerry G. "A Report of the Science Education Needs/Interest Study in the University of South Dakota Service Area." Unpublished Technical Report, University of South Dakota, 1974.

13. Krieghbaum, Hillier and Hugh Rawson. An Investment in Knowledge. New York: New York University Press, 1969.

14. National Advisory Council on Supplementary Centers and Services. Innovative Education Practices. Washington, D.C.: The George Washington University, October, 1973.

15. Purnell, Charlotte H. The Delaware Model: A Systems Approach (DEL MOD System). Dover, Delaware: DEL MOD System, March, 1972.

16. Reeler, Thomas H. and Jerome R. Shapiro. "A Focus on the Cooperative Reorganization of Pre-Service and In-Service Teacher Education Programs." Bureau of Educational Personnel Development, Division of Assessment and Coordination, Washington, D.C., 1971.

17. Ruff, Thomas P. "How to Use the Consultant," Educational Leadership, 31:506-508, 1974.

18. VanRyn, Mike and Mary VanRyn. "Survey Inservice Education." PBTE (Performance-Based Teacher Education), 2:1 and 8, 1974.

19. Wailes, James R. "History and Development of National Science Foundation Elementary Institutes, 1959-1967." Unpublished Manuscript, University of Colorado, 1968.

20. Watkins, Roger (ed.). In-Service Training: Structure and Content. London: Ward Lock Educational, 1973.

21. Zoller, Uri and Fletcher G. Watson. "Teacher Training for the 'Second Generation' of Science Curricula: The Curriculum-Proof Teacher," Science Education, 58:93-103, 1974.

STRATEGIES FOR INSERVICE TEACHER EDUCATION IN SCIENCE:

A REACTION

Ronald S. Ellis
Herbert H. Lehman College of the
City University of New York
Bronx, New York 10468

Teachers of Science Need Relevant and Viable Inservice Education

Inservice education is important to science education. Many of the problems stated by first-year teachers imply their inservice education needs; many of the rationales given for new programs imply the inservice education needs of incumbent teachers. The need is not so much for quantity elsewhere in the country as it is in sparsely-populated areas. Rather, the focus should be on what kinds of services are being brought to teachers of science in the classroom. This need for shift in focus is true on all levels of the educational structure: elementary, secondary, and collegiate. It is also true in all areas of the country: urban, suburban, and rural.

Inservice teacher education is just as crucial for high school and middle school teachers as it is for elementary school teachers. This is particularly true for the areas of science and mathematics. The results of a two-year study reported by Collea (2) indicate the importance of inservice education. Collea's study was designed to monitor the intentions, perceptions, and classroom verbal behavior of first-year science teachers. The results indicated that conflicts developed between the teachers' desire to establish rapport with students and their desire to establish authority and maintain discipline.

Another finding showed the way in which new teachers perceived their own roles conflicted with the way their roles were viewed by others such as supervisors and principals. Most of the new teachers in the study were well-prepared in the content area. However, these same teachers found it difficult to teach at the levels and in the range of pupil abilities required in their schools. Nor were these teachers prepared to take full advantage of the resources that were available to them.

The list of problems identified by the first year teachers of the Collea report indicates that their preservice training did not prepare them in all of the ways in which they would be required to function as teachers. Preservice training for these teachers did not meet the needs implied by the list of problems which were generated. This means that not only preservice education but also inservice education must be carefully structured. The structure of inservice education should be designed to meet the needs and help provide for solutions of the problems encountered by the teacher faced with educating children in a rapidly changing society.

The need for inservice training is one that is more qualitative than quantitative. Certainly there are many traditional inservice programs in the more densely-populated sections of the United States. Nevertheless, there is very little evidence that very many programs have been effective in helping the teacher to relate instruction to the rapidly changing schools.

Lunetta, Yager and Sharp (7:497) describe today's school as continually changing in the following areas:

1. the role of administrators, teachers, paraprofessionals, and other school personnel;
2. financing;
3. the nature and background of students enrolled;
4. the nature and focus of support given by the community for its traditional functions;
5. goals and objectives are being redefined and refined;
6. society's and the educator's understanding of the traditional teacher-learner roles and how these roles interact is changing; and
7. society itself is rapidly accelerating.

Lunetta et al. listed the above factors in connection with their statement of rationale for their own Science Teacher Education Model, a model for the training of new teachers. However, most of the teachers who will be in the various schools for the next twenty years are already there now.

At the very least, the above-mentioned factors of change raise questions which must be answered. What is the best way to train a prospective teacher? Can the behavior patterns and attitudes of the teachers now in the schools be adequately examined and changed where necessary? Where does the responsibility for planning, implementing and monitoring this change belong?

Our focus of inservice education must be in terms of quality of service provided for the teacher. Some of the models for inservice education reported in the literature have focused on what, in my opinion, seems to be the wrong end.

The extern-intern program described by Riechard (9) pairs two persons in an elementary school classroom. The experienced teacher supervises the intern. Gradually the intern is prepared to assume the full responsibility for the classroom by the end of the academic year.

The concept of pairing experienced and inexperienced teachers is not new. It is an excellent idea. It provides the close supervision and guidance for the inexperienced teacher (intern) that would be most likely to ensure success. However, the report does not indicate how the needs of the inservice teacher (extern) are assessed. It is important for science educators to know how this assessment is carried on by others. The externs in the Riechard report are enrolled in on-campus, credit bearing courses. It is important for us to know the criteria for the inclusion of these courses in the curriculum. We must also know whether these courses help the inservice teacher (the extern) to become more effective as a teacher.

The input of the teacher in the planning stages of an inservice program is extremely important. If the program is intended to help to make the teacher more effective, the learning experiences in the program must be relevant to the teacher's needs.

McLeod (8) proposes a model that seems workable, requiring student teachers to free cooperating teachers for inservice. This idea is not entirely new. What would be new is a detailed description of the mechanism whereby the planned program of professional development referred to in the report is devised. There is a need for early "grass roots" involvement in the planning of viable and relevant inservice programs. The key word is "viability." It does no good to establish programs that are ineffective and therefore do not substantially improve instruction.

Draba (4) proposes some guidelines for viable inservice education programs. These ideas may be helpful to us as we consider inservice education for teachers of science in greater detail. Viability, again, must be considered. To plan and implement a program that will meet the objectives of improving instruction in science, the inservice planner should:

1. emphasize the benefits;
2. encourage voluntary participation;
3. limit group size;
4. identify problems;
5. set feasible goals;
6. share the planning;
7. plan divergent activities;
8. enlist administrative support;
9. arrange for released time;
10. provide for evaluation;
11. make adjustments; and
12. make inservice continuous.

It is important that those being served by inservice education programs be given the opportunity to have input early in the planning phase.

The Issue of Responsibility and Control

An important issue that relates to the viable and relevant planning of inservice education for science teachers involves responsibility and control. Inservice education should consider and utilize the resources and expertise of the colleges and universities, the school districts, and the teachers. One point of view on the matter is that equal power is a necessary prerequisite to collaboration for progress.

Hough (5) discusses the significance of establishing and maintaining a larger number and variation in the types of ongoing relationships between schools and colleges. In this editorial, Hough also lists the advantages and assets of both the school district and the university. The author points out, however, that both the school district and the university must have equal power in decision-making. Both must agree before decisions regarding programs are made and implemented. This, Hough says, is "a key to effective collaboration." Effective collaboration, if attained, could provide science educators and teachers of science with many more viable programs that would contribute considerably more to the improvement of instruction for children, adolescents, and adults.

Decreasing student enrollments in teacher preparation institutions coupled with the increasing demand for accountability in the schools should be a powerful incentive for collaboration. The problems created by these factors should drive the school districts, the colleges, and the teacher organizations into closer cooperation. The Macomb County Teacher Education Council (8) provides a model. The Council's attempt to solve its problems could partially serve as a model for others also attempting to solve similar difficulties. The purpose and principles stated by McLeod provide for the formation of a consortium or council. This council would provide input into the planning, development, field testing, implementation, and evaluation of programs and modules designed to train and professionally develop teachers.

Another point of view is that school boards must retain ultimate control within the context of collaboration. According to Calhoun (1) there is no question that there must be an increase in the time and energy spent in devising and implementing means of retraining and up-grading existing personnel. The state of Delaware has developed a consortium between the Department of Public Instruction and institutions of higher learning. Their focus has been on the improvement of science and mathematics instruction. With state, federal, and industrial funds, enough inservice courses have been made available on college campuses in each county to "substantially upgrade much of the teaching in target areas" (1:312).

Calhoun believes that the concept of joint rights is antithetical to the concept of constitutional authority upon which the public school system is founded. It has been established above that common interests and concerns exist between boards of education, their constituents, school administrators, school personnel and university faculties. Nevertheless, Calhoun suggests that careful consideration must be given to the term "partnership" and the implications it holds for staff development.

Eventual control by any one group of the public educational system for the purpose of planning and improving the welfare of that group should not be permitted. All groups which have common interests and concerns in the public education system should be allowed to have input. They should be given the opportunity to be involved and to collaborate throughout all phases of inservice education.

There is an issue that revolves around the question of responsibility and control in the context of collaboration. Although schools, colleges and other institutions need to cooperate in order to find solutions to their common problems, it is not clear where the ultimate control should rest. Calhoun feels that it should rest with the duly-elected boards of education. Certainly, many boards of education have not discharged their responsibility adequately with regard to inservice education. The colleges and universities have resources and personnel which could help in finding solutions. Teacher organizations could help to identify many of the needs for planners of viable and relevant inservice programs. The answer probably lies in some sort of compromise. All parties or groups which can provide input should be permitted to do so. Boards of education should be focused so that the needs of all who are involved in the collaboration are met. The ultimate goal of meeting those needs should, above all, be the improvement of instruction for the students.

Some Existing Answers Provide Clues

The responsibility for ultimate control constituted within boards of education cannot be discharged adequately in isolation. To be sensitive, boards of education must utilize the input and expertise of at least the major groups concerned with the improvement of instruction.

Dillon (3) proposes a plan which outlines the areas of expertise and responsibility for the school districts, the teacher organizations, and the colleges of education. The plan indicates the nature of the involvement of each of these groups in the following areas:

1. the identification of need;
2. the designing of the staff development plan;
3. the implementation and monitoring of the progress of the plan; and
4. the evaluation of the plan's effectiveness.

Dillon's plan provides some guidance as to the steps which may be taken by those responsible for ultimate control. Sharing the responsibility and seeking input from those groups endowed with the appropriate expertise enables school boards to increase their sensitivity where it is needed most.

The literature provides us with many other models. Each has components which any given board of education may accept or reject. The model suggested by Collea (2) divides the problem into two phases; it proposes a preservice cognitive training phase and an inservice affective training phase. The inservice phase of Collea's proposed model suggests that a shift in the new teachers' training from the college campus to the school district will accomplish one important task. It is believed that this shift will be instrumental in creating programs that are more flexible and more responsive to the needs of the new teachers. Collea believes that school district based programs are potentially more capable of solving the problems that new teachers face than are college-based inservice programs.

The inservice phase of Collea's model would concern itself with the affective side of teacher preparation. The small group format would be utilized. Included in those groups would be other school personnel such as experienced teachers, principals, district office personnel, and college faculty as consultants on an as-needed basis. Such a group would enable all inservice staff (especially teachers) to investigate "such issues as leadership, affection, control, decision-making, and consistency in classroom situations" (2:366-367).

Florida's Department of Education provides another viable model from which boards of education may select relevant components. By using all available resources (i.e. university, school district, state governmental and private agencies) the Florida Department of Education was able to plan and implement an inservice concept. Their inservice concept was reported as being extremely efficient in its use of time and resources. Almost half of Florida's classroom teachers were exposed to inservice training in environmental education for two to three days at a cost of less than ten dollars each.

Tillis and LaHart summarize the concept in the following words:

> By teaching teachers to teach other teachers, a multiplier effect is achieved. . . . This plan provides teachers with the methods for holding similar workshops by involving them in planning, conducting, and evaluating these workshops (11:160).

Other reports in the literature provide more of the pieces that may be useful to boards of education seeking to build their own inservice programs. The results of the evaluation of a program of inservice training which focused on the use of advisors is encouraging in a number of ways. One of the encouraging factors relates to the identification of the positive characteristics of the inservice advisor. It was determined that the following qualities tend to enable the advisors to be more effective in carrying out their tasks. If the advisor has the following characteristics, he will be able to function in a manner more meaningful for children and their teachers:

1. has the appropriate expertise such as background, experience and skill in demonstrating activities;
2. possesses honesty;
3. is gentle;
4. lacks defensiveness;
5. is constructive; and
6. is resourceful.

Such a person could more readily be objective and fair and provide constructive help (6:157-159).

Although ultimate responsibility and control rests with the boards of education, the solution to the problem posed by the issue raised is not a simple one. Neither is there one solution for all situations. Calhoun sums it up in the following manner:

> While colleges and universities must offer basic training in content and methodology to their prospective teachers, it is impossible for them to predict what skills and concepts will be most appropriate in 1980 or 1990. Yet simply to lament the difficulty of predicting and planning for what we think the future will demand of teachers is nonproductive. Some universities and school districts, therefore have decided that it is more productive to screen prospective teachers for desirable personal qualities and then to foster the adaptive attitudes and the abilities necessary for continuous improvement during their professional careers (1:311).

Quality, Not Quantity, Is The Urban Need

The literature provides numerous examples of the many types of inservice models being implemented throughout the United States. This need for inservice education in science teaching is reflected at the elementary, secondary, and college levels. It exists in the cities as well as in suburban districts and in sparsely-populated rural areas. For science educators in cities, an important area of concern is the quality of inservice education provided in densely-populated urban areas. What model should be adopted by boards of education? Criteria must be established to determine the usefulness of various components of different models.

In an editorial discussing the importance of school-university partnerships, Hough (5:308-309) lists several examples of the types of programs already operational. In his opinion, these programs are viable for promoting teacher growth and for improving the opportunities for children to learn. It appears that two of these models contain the greatest potential for promoting growth in the urban setting: the Interdisciplinary Teacher Education model and the Inter-Institutional Workshop. Each of these can be implemented with relative ease and each provides the greatest tangible benefit for all involved. The presence of teams of professors at the schools is the significant component of the former program. The development of curriculum by teachers and administrators for credit is the significant component of the latter program. Both of these concepts in inservice education would help to generate a positive working relationship between the college and the school.

Of course, the urban setting would demand that some modifications be instituted in the models suggested by Hough. There could be the development of a hybrid model. The hybrid model could combine the useful factors of both models and incorporate parts of other models. Once the dialogue was opened between the college and the school, it could be nurtured and maintained. The presence of college and university faculty in the schools would be a positive factor that would help to maintain open lines of communication. College and university faculties which are more clearly oriented toward research and better equipped to plan and implement research would be available to school districts. Schools, on the other hand, could more readily identify problems in need of research and implement changes suggested by research.

All of the models mentioned above have merit for the urban setting. However, the confusion and ambiguity about the roles and responsibilities tend to impede progress (5). The public institutions, teacher organizations and local community groups must work together so that innovative models for inservice education in science teaching can be developed. Such models must contain relevance for improving the quality of science instruction delivered to urban children and adolescents.

What constitutes relevant inservice education for science teachers can best be stated by the teachers themselves. The results of the administration of two questionnaires to 309 educators in Washington state reported by Stronck provides some clues. The questionnaires were concerned with the Goals of Science Instruction and the Needs for In-Service Programs. The results indicate the topics which teachers felt were most significant. The following topics should therefore be included in every inservice program that proposes to meet the needs of classroom teachers:

1. coordination of the sequence of scientific concepts and processes from K-12;
2. recent advances in scientific knowledge;
3. relevancy of scientific concepts to the lives of students;
4. the effective management of curriculum materials;
5. the individualization of instruction; and
6. ways to evaluate the quality of instruction (10:508).

The consideration of a total science teacher education program must incorporate inservice education. Lunetta et al. (7) succinctly state the criteria for a model science teacher education program. They list the three factors which must be included in any program that has life and potential for growth. They list:

1. planned exploration of science teaching as a career possibility with a variety of entry and exit points;
2. a continuing association with teachers and students throughout the preparatory program; and
3. a series of experiences designed to minimize the preservice-inservice interface.

It is my feeling that the transition between the preservice and inservice education for teachers of science is crucial. Schools, colleges, teachers, and community groups must give serious attention to the continuity of learning experiences for the professional as he moves from the preservice phase of his professional development. The planners and developers of the total teacher education program must remember that science teachers must always have access to professional development. If we accept the fact that the society and the schools are rapidly changing, we must recognize the need for helping all science teachers to maintain the appropriate level of knowledge, skills and attitudes.

Assessment Is One Key

There are many models for inservice education from which boards of education may select components to construct viable, relevant programs for urban teachers of science. There is probably no one model which possesses all the components required by any given district or school. The literature suggests that collaboration among the various interest groups in education will be required if viable, pertinent inservice science education programs are to be developed. Furthermore, inservice programs must be ongoing since society and the schools are rapidly changing.

Finally, science educators will have to focus their attention more intently on the assessment of the inservice programs for teachers of science. More work needs to be done in program evaluation. There is a need for more information about how effective these many models have been. We need to know what factors contribute to the successes and failures of the models we plan and implement. New relationships must be established between the schools, the colleges, and the teachers. The relationships must be of the type that will foster openness. The relationships must provide for meticulous assessment of the professional strengths and weaknesses of the inservice program participants. It does no good to establish inservice programs for science teachers that do not contribute substantially to the improvement of science instruction. We must do everything in our power to help science teachers to increase their knowledge, develop more positive attitudes and refine their skills. Only then can science educators be certain that science instruction will continually be improved.

REFERENCES

1. Calhoun, Thomas. "Throwaway Teachers?" Educational Leadership, 32:310-312, February, 1975.

2. Collea, Francis P. "A Model for the Preservice Training of Science Teachers Based on the Intentions, Perceptions, and Verbal Behavior of First Year Science Teachers," Science Education, 58:363-367, July-September, 1974.

3. Dillon, Elizabeth A. "Staff Development: Whose Job Is It?" *Educational Leadership*, 32:137-140, November, 1974.

4. Draba, Robert E. "Guidelines for Viable Inservice Education," *Journal of Reading*, 18:368-371, February, 1975.

5. Hough, Wendell M. "School-University Partnership for Teacher Growth," *Educational Leadership*, 32:307-309, February, 1975.

6. Katz, Lillian G., *et al*. "The Advisory Approach to Inservice Training," *Journal of Teacher Education*, 25:154-159, Summer, 1974.

7. Lunetta, Vincent N., Robert E. Yager, and William L. Sharp. "Needed: New Models for Science Teacher Education," *Science Education*, 58:497-503, October-December, 1974.

8. McLeod, Pierce H. "A New Move Toward Preservice and Inservice Teacher Education," *Educational Leadership*, 32:322-325, February, 1975.

9. Riechard, Donald E. "A Method That Can Make a Difference," *Journal of Teacher Education*, 25:163-165, Summer, 1974.

10. Stronck, David R. "The Attitudes and Needs of Inservice Science Teachers," *Science Education*, 58:505-508, October-December, 1974.

11. Tillis, C. Richard and David E. LaHart. "Teachers Teaching Teachers - Inservice Training in Environmental Education," *Journal of Teacher Education*, 25:160-162, Summer, 1974.

INSERVICE EDUCATION: A MODEL FOR ROLE REORIENTATION[1]

Bernard W. Benson
The University of Tennessee
Chattanooga, Tennessee 37401

Universities are in the business of inservice education as one of their major endeavors. In a recently published status report on teacher education, Sherwin (25) stated that 74 percent of the responding colleges and universities provide inservice workshops for teachers. This level of involvement suggests a plan for consolidated action involving cooperation among all agencies and institutions concerned with education. Inservice education needs focus, direction and perspective. We must view our role in inservice education as an integral part of our many professional activities. Inservice education must be given a high priority. No other professional endeavor has greater potential for personal gratification. The involvement of college science educators in inservice education can no longer be only a sideline, a way to supplement income, or a means to fulfill community service obligations.

What is needed in inservice education is a workable model which can serve to direct the professional growth of the total teaching profession. It must be holistic in scope and applicable to each individual or group within the profession. It must also allow for self-assessment and continuous change.

Such a model will be proposed in this paper. It will be formulated out of 1) an examination of the recent literature on inservice education, 2) a focus on what the author considers to be the key problem facing inservice education respective to the inservice education process, and 3) a review of the existing models for inservice education. The description of the new model will be followed by a discussion of where the responsibility for implementing this model lies.

This paper is written for college science educators although it is applicable to the total science teaching profession. If the position set forth in this paper is judged meritorious, the precepts of the paper could then be reviewed by the total science teaching profession.

Classification of Key Ideas

One interesting observation about inservice education literature is the conviction with which the authors write. There are many profound statements which provide most of the answers to most of the questions one could possibly ask about inservice education, but there are few if any solutions. Rather than weave these key statements into a lengthy narrative, a classification of key ideas will serve to illustrate the state of the thinking in this area.

---

[1] Supported by a grant from The University of Chattanooga Foundation of The University of Tennessee at Chattanooga (920910-43668).

Perceptions of Teachers and the Teacher's Role in Inservice Education

> Professional growth should be personalized, allowing teachers to cope with their own idiosyncratic needs, to begin at their own level of sophistication and to progress at their own optimal rate (24:250).
>
> Teachers may be the most reliable judge of their own weaknesses. It follows, therefore, that the teacher should have a fundamental voice in determining his inservice training program (4:57).
>
> Teachers value an inservice program in terms of how much it deals with the practical problems of the classroom (13:37-38).
>
> Teachers would be willing to participate in research and organize their own inservice work if time were provided (5:77).
>
> Most teachers prefer a discovery oriented approach to inservice education (29).

Concern for a Shift in Responsibility for Inservice Education

> All segments of the profession should be involved in the planning and implementation of inservice programs for constructive professional growth (26:178-190).
>
> Assistance should be provided to teachers in such a way as to increase the likelihood that teachers become more self-helpful and independent rather than helpless and dependent (28).
>
> More programs are needed that result in self-sufficiency and minimize dependence on the leaders, professors or developer (27).
>
> Preparing a teacher to teach other teachers requires activities different from those which are required to train a teacher to teach (18:147).
>
> Instead of going after a teacher proof curriculum, we would do better to work toward a curriculum proof teacher (24:264).

There is a need for roles and institutions intermediate between schools and the agencies of curriculum change (11:98).

Problems Facing Inservice Education

The most persistent problem in inservice education is the lack of sufficient time to do the job (28).

There is a need to develop methods for finding and training people for new kinds of leadership roles (19:226).

Limited inservice development programs are conducted through an uneasy liaison between school systems and colleges and universities, neither of which agencies is in a position to put important financial support into them (14).

Sufficient money has been spent on inservice education to permit us to conclude that money alone is not the answer (8:189).

Federal support has been directed chiefly to a wide range of small specific training programs (14).

For the improvement in both competence in science and teacher attitude, a released-time format for teacher training is more effective (17).

Far too few secondary teachers are reaping the benefits of an adequate program of inservice education (7).

Approaches must be developed that are applicable to all teachers and not just the aggressive and/or most capable to begin with (16).

Additional care should be taken to help the older and more experienced teacher to understand the newer material he is expected to learn and subsequently teach (23).

Lack of subject knowledge more than anything else is the main reason why teachers fail (3:22).

Perspectives on Inservice Education

Professional education should be considered as a whole rather than as preservice and inservice (27).

> Teacher education should be viewed in the framework of continuous learning, self-evaluation, and self-renewal beginning when a student first considers becoming a teacher and continuing throughout his career (1:41).
>
> Inservice education is as much a problem in the universities as it is in the elementary and secondary schools (4:42).
>
> Teacher inservice education should emphasize instructional alternatives rather than single methods (4:70).

Trend Toward Accountability and Performance Criteria

> The only true "index" of a program's quality lies in the teacher's classroom performance and ultimately in the student's learning (4:65).
>
> There should be less emphasis on the short performance objective workshop and more emphasis on well coordinated behaviorally evaluated instructional systems (27).
>
> Inservice programs should be appraised in terms of student (child) performance (27).
>
> The certification of inservice teachers should be tied closely to carefully articulated and successfully completed inservice programs and should not be of indefinite duration (2:29).
>
> The notion that credit gathering is the only or most important way to acquire inservice skill or promotion needs to be drastically revised (2:29).

This collection of statements is representative of current views on inservice education. It is not an all inclusive list of desirable goals for inservice education, but most science educators would probably support the majority of such statements. However, when considered separately, categorically, or *in toto*, these statements offer few solutions. Those of us involved in inservice education can review this list and identify many of the elements of our existing programs—programs which have been reasonably successful, at least from our own vantage point. Under the side heading, *Problems Facing Inservice Education*, only the last statement would spark controversy. A workable solution would be closer at hand if the content versus pedagogy argument were our only problem.

We have not been able to cope with the resolution of several problems at the same time. In any human endeavor there are too many variables to hold constant or manipulate. This dilemma is not new to us, but it would be helpful if we could identify one element to manipulate within our complex inservice systems that would serve to increase our level of understanding respective to how the inservice process works.

The Key Problem Facing Inservice Education

College science educators have their own sets of priorities as they translate their individual beliefs into individual behaviors when working with classroom teachers. They recognize and usually respect divergent points of view. They consider themselves to be open-minded and receptive to new ideas. They sense that their personal philosophies evolve and they are comfortable with these changes in "self." They take pride in their accomplishments and experience self-fulfillment in what they believe they have accomplished. But do these characteristics of our professional growth as college level science educators hold for pre-college teachers? I think not. In the inservice realm, pre-college teachers tend to be more on the receiving end. The exchange of views and knowledge is not as refined within their ranks as it is with college teachers. There is more effort expended in college personnel trying to influence pre-college teachers than in pre-college teachers trying to influence one another. In very subtle ways, the long range effect of this approach to inservice education has resulted in confusion.

Inservice educators cannot be distinguished on the basis of what they say they believe, or believe they have done, but on the basis of what they actually do to teachers. Pre-college teachers are a much more divergent lot than college professors. They have very different needs and respond quite differently to alternative approaches. The potpourri of approaches and formats for inservice education (not just in science) is varied and often contrasting, but we have no way of knowing which approach is best for any given teacher. It is no wonder that our efforts to influence some teachers' behaviors often fail. It is also apparent, and probably much more important, that classroom teachers have had little influence on our behavior. We need to be sensitized to the cumulative effect we can have by exploring new leadership roles for both pre-college and college-level educators in the inservice process. This can be accomplished by all of us, including classroom teachers, by striving to better understand our individual contribution to the whole process.

The major problem in the area of inservice education is in the development of this kind of sensitivity. It will not be developed unless an overt attempt is made to change the philosophical orientation which underlies inservice education.

Before attempting to propose a solution to this major problem of inservice education, two elements within the last paragraph need to be clarified. First is the need to examine what is meant by the "whole process." Secondly, the idea of "sensitivity" as it relates to the role of the inservice educator requires expanding.

Defining The Inservice Process

Should the process of inservice education be defined in operational terms? Doing this would assume, however, that what we do to teachers or what happens to teachers involved in inservice education has impact and can be directly related to how teachers perform. It also assumes that we can measure the effect teachers have on student performance. Defining inservice education operationally would not be appropriate at this time, and maybe it should never be. "We must do what we believe is right rather than what we know will pay off" (12:33). Thus, the inservice process should not be reduced to objective criteria alone.

Hewitt (10:41) termed inservice education as any structured educational experience undergone by a teacher in service. Deleting the word structure from this definition would result in even broader meaning. (Inservice education is any educational experience undergone by a teacher in service.)

Jackson (12:21-29) presented two perspectives on inservice training that could serve to expand this definition. He called one perspective the "defect" point of view and assumed that "something is wrong with the way practicing teachers now operate and the purpose of inservice training is to set them straight--to repair their defects, so to speak" (12:25). This idea, which seems to hold high priority in the way we often view teachers, does indeed reflect a need for training or as many like to call it, "retreading." As concerned as we say we are about not instilling our own values upon classroom teachers, we often find ourselves doing exactly what we say we should not do. Like it or not, much of our interaction with teachers is at the "training" level.

Jackson (12:26-28) labeled a second perspective the "growth" approach. This approach assumes that teaching is a multi-faceted activity about which there is more to know than ever can be known by any one person. "The motive for learning more about teaching is not to repair a personal inadequacy as a teacher but to seek greater fulfillment as a practitioner of the art" (12:26). Science educators tend to think much the same way when they talk of self-renewal. To actualize self-renewal in every teacher would embrace all that has merit in inservice education. In Jackson's (12:26) terms "successful teaching stems from the teacher's desire for self-fulfillment rather than from his mastering of a collection of techniques." This would mean treating the teacher as a professionally competent person (4:37).

The level of professionalism operating within our schools provides a way of viewing the process of inservice education. Hoyle (11:97-98) distinguished two types of teacher professionalism. In the restricted sense, he defined professionalism as a high level of classroom competence, teaching skill, and good relationships with pupils. It is in this area that science educators have focused their efforts to date. In extended professionalism, however, Hoyle included other attributes of teachers. Teachers see their work in the wider context of society. They insure that their work is informed in theory, research and current exemplars of good practice. They are willing to collaborate with other teachers in teaching, curriculum development and the formulation of school policy. They have a commitment to keeping themselves professionally informed. Although as educators we see the value in extended professionalism, it is apparent that a shift in this direction necessitates a higher level of coordination and cooperation than now exists among all those involved.

Rubin (24:245) concluded that teacher professional growth has not been taken seriously. He stated that it lacks a systematic methodology and has been managed with astonishing clumsiness. Although the process of inservice education lacks a systematic methodology, what is needed is a form of ubiquitous sensitivity. This is the main problem facing inservice education today. The nature of this sensitivity and its present lack will be made apparent in the following section.

The Nature Of Sensitivity

College level science educators display a lack of sensitivity in many ways as illustrated by the examples given below. These examples are not intended to cast aspersion on the profession but rather to dramatize the need to shift our philosophical orientation in order to achieve a higher level of success in the inservice realm.

As stated earlier, college level science educators are able to cope with controversy stemming from within their own ranks. They are, however, less sympathetic to the views of so-called outsiders or generalists who tread on common inservice ground. An example from the literature will serve to illustrate this contention.

During a two year study, Norman (20) found teacher reaction to inservice work stressing human relations techniques rather than new teaching methods and materials overwhelmingly favorable with all except a few skeptics. It may well be that Norman's population had never experienced an NSF program, or it may be that the NSF workshops they attended lacked any affective qualities which could have had impact on developing teachers' self-concepts. This is precisely the premise of Cohen's (6) thesis when he rejected the idea of "retreading" science teachers. Our highly organized programs emphasizing performance and laboratory work could have produced tensions and anxieties that served to alienate teachers. We have not been sensitive to teachers' needs, and in like manner Norman was not sensitive to our need to perpetuate the "defect" point of view. Our emerging curricula should pay close attention to alternative approaches to inservice education. They should capitalize on the expertise of both generalists and specialists.

It is also recommended that the teacher development efforts of ISIS, USMES and other emerging curricula give high priority to the convergence of behavioral and humanistic philosophies. Ost (22) defined the humanistic movement as "an attempt to consider the individual as a unique person with the ability to experience and interact with reality." It is, however, quite conceivable that in the translation into practice through teacher development programs, we will operate much as we have done in the past. We will apply our old values and standards to the new programs just as we have criticized classroom teachers for doing the same to the new curricula of the sixties and early seventies. We have admittedly stressed cognitive activities and, at best, only indirectly alluded to affective activities (and concerns) of the teacher (6). We are insensitive to the unique problems that arise when converting theory into practice.

There is another form of sensitivity that we fail to recognize. Occasionally our profession has been involved in or has witnessed the production of guidelines and professional standards. Such undertakings are initiated for the purpose of rethinking and redesigning teacher education in science. For example, many of us were involved in the development and subsequent discussions through AETS meetings on the Guidelines and Standards for the Education of Secondary School of Science and Mathematics (1). Several of the guidelines and standards in this document relate directly or indirectly to inservice education in science. Preservice and inservice education in science is presented as a continuum of experiences. How have these guidelines been used? How have they been implemented?

In the document in question, suggestions for implementation are listed beginning on page 52. Colleges and universities preparing teachers were directed to: 1) arrange for discussions of the guidelines involving a wide cross-section of participants, 2) use the guidelines in stimulating the development of strategies, competencies, and general approaches for the improvement of teacher education in all areas, and 3) compare the guidelines with state-adopted teacher preparation programs and standards to identify possible conflicts. These recommendations are representative of the proposed uses for this document.

To what extend has this document been utilized at your institution? In terms of the extent to which these guidelines have been implemented, can we justify the cost involved in their production? Granted such guidelines in many instances have been used as a retrospective tool when our institutions undergo NCATE certification--yet another set of guidelines that we are compelled to address ourselves to every few years. All such guidelines are rather postholes that can be touched when the need arises. Most of the time educators pay them little heed. When we do dig them out we have found through experience that it is a simple matter to draw correspondence between what we do and what we ought to be doing, vis-a-vis the guidelines. What the profession is doing does not seem to be nearly as important as our ability to describe what we should be doing. What is most devastating, however, is that we tend to believe our own propaganda. We are, in this sense, often insensitive to the devious ways our own minds work. We are also insensitive to the mindlessness of the systems imposed upon us. We soon pass the point of questioning these systems and from then on do what we think we ought to be doing.

It is evident that the process of inservice education is complicated. Because of our own insensitivity, we are unable to cope with the matter of changing our perspective toward it. We are concerned more with the role we have given ourselves to play in terms of the influence we believe we can have upon teachers. We have not viewed inservice education in terms of alternative roles for ourselves. We operate within a framework which does not allow this. An effective model for inservice education would serve to sort out these endemic problems and provide focus and clarity to the whole process. The existing models described below have fallen short of accomplishing this. A review of their basic components will reveal their inadequacies.

Existing Models For Inservice Education

Stone's (26:178-190) Six Stage Developmental Paradigm for innovative curriculum experiences in teacher education is one example. This hierarchical model develops along a time continuum. This model is described in Koutnik's (15) paper on inservice education. From "Idea to Action" to "Changes in the Community," this model describes a developmental sequence which could be applied to inservice education. Noteworthy is the fact that Koutnik failed to find any evidence for applying a modification of this paradigm to science education _per se_. More importantly even if such a model were applied, there is nothing inherent in the model that would direct the development and implementation of programs patterned after the model in such a way as to assure success. The collective behavior of any group resulting from a high level of interaction of many individuals over a long period of time is difficult if not impossible to predict.

The USA, England and many other countries have operated for the most part using the Diffusion Model (11:93). This approach involves the controlled development of new curricula and their planned dissemination in the schools. The current Instructional Improvement and Implementation Program of NSF is a typical case in point. Such models, however, are not without problems, as Hoyle (11:93) has pointed out. One problem is the distorting effect of adaptation. The second problem is the lack of sustained commitment by classroom teachers to an innovation. Although the guidelines for writing NSF III proposals have been modified to minimize this effect, it remains to be seen whether this situation has been ameliorated. In spite of our efforts to circumvent such problems, they will probably still be with us.

Havelock (9) has assimilated from the literature three main models or orientations which are used to describe the dissemination and utilization process. In consolidating aspects of each model, he stated that the major need is to build national systems which allow school districts to plug into the most sophisticated sources of information in order to get knowledge and materials which are relevant, timely and truly cost beneficial. He stressed the importance of comprehensive resource linking agencies--a continuous chain of interdependence and two-way linkage from researcher to developer to practitioner to consumer.

One assumption of such an approach is that teachers will become committed to the changes which they themselves have initiated. Schools need help in this effort. "Procedures for converting grassroots innovations into a common stock of educational knowledge are at the moment rudimentary" (11:95). Thus, it is an exciting thought that such approaches could be incorporated into some of our emerging curricular projects. Conversely, there are still no built-in assurances that such efforts will ever reach fruition on a national level.

With this foundation a new model will be proposed. The model will be introduced by comparing its basic premise with an institution that has gained prominence in inservice education--the Center.

The idea of centers has become so widespread that they probably represent one of the ubiquitous trends in education, and especially science education. Nearly every university has its science teaching center although its outstanding feature may be nothing more than a sign above a door or a line in a letterhead. They serve as repositories of curriculum materials, as sites for inservice programs, or as bases for providing services to local or regional teachers. Some have even grown to claim networks coordinating efforts for an entire state. Quite like our interpretations of the "open classroom," centers are usually viewed by most in terms of their physical environment or in terms of the services they purportedly provide. There is a form of philosophical orientation implicit in many centers that is indicative of the "defect" point of view. The concept of centers, unfortunately, often lacks the qualities that only ecotones can provide. This construct--The Ecotone--will be the major premise of the model for inservice education set forth below.

The Ecotone Model For Inservice Education

Anyone who enjoys birding as a hobby knows that there are more birds within ecotones than within the individual communities. Ecotones are where the action is. One thing that ecotones are not is centers. They are not points in space from which everything else converges or diverges. They are rather broad bands between contiguous biological communities characterized by their high level of interaction. Every component within the ecotone is part of it. It provides an open system of entry and exit. Every mobile component within the separate communities can visit the ecotone and often must for its own survival.

Odum (21:278) stated that such transition zones often support a community with characteristics additional to those of the communities which adjoin it.

> Unless the ecotone is very narrow, some niches, and therefore, some organisms are likely to be found in the region of the overlap which are not present in either community alone. Since well developed ecotonal communities may contain many organisms characteristic of each of the overlapping communities plus species living only in the ecotone region, we could not be surprised to find the variety and density of life greater in the ecotone (21:278).

From this perspective, what we now refer to as inservice education could not be labeled as an ecotone for there are few personnel who function only in inservice education and there is certainly less activity (density) within its boundaries than in the overlapping communities (school systems and universities).

Centers can come and go. The center's support services are helpful but not vital, but as long as there are distinct communities there will always be ecotones. In education we have failed to recognize the existence of ecotones, have failed to take advantage of their potential, or have failed to see that they shift. There is far greater reward in having developed a center or in being part of its operation than there is in having received services from it. To be part of an ecotone relationship requires a new and different philosophical and professional orientation.

An ecotone approach will allow us to take advantage of the natural channels of interaction that occur among our species given the resources at hand. Obviously the resources at hand are not adequate. As educators, we hold a low position in the "pecking order" for funding and as science educators our relative position is getting worse. Whether this motivates college science educators to act as they do is difficult to determine. Yet, it is quite clear that they are operating under a double standard. They convey the meek image of missionaries with limited vision but well indoctrinated in doing their good deeds for the good of the cause, but in actuality they put most of their efforts into channels that are self-serving. In the inservice realm, their deeds are often evangelistic. Whatever they say, they are still being guided by the diffusion model. As with most evangelists, their potential parishioners are often suspicious of them--not the few that they have converted but the masses that are yet to be "saved." This suspicion is justified. From the ecotone perspective, they are interlopers--intruders to the ecotone.

This is a critical point. College science educators are intruders because of the role they have assigned themselves. They are presently inclined toward giving and not receiving. They remain unchanged. They are not involved in inservice education as learners but as teachers. They could justify their role by stating that not all relationships are mutualistic, but it would be difficult to defend other forms of symbiosis as having greater potential for success. Relationships resulting in mutual benefit are inherently more desirable than relationships resulting in benefit or harm to one of the participants.

As intruders with even the best of intentions, college science educators fail to realize the long range effect of their interaction with classroom teachers. College science educators lack credibility because they are not really part of the natural system, and they are insensitive to how important "belongingness" really is.

If we look at inservice education as an ecotone, we must be resigned to the fact that, with their present perspective, college science educators will always lack stability and permanence. This pervading theme can be likened to the encroachment of members of one community upon another while ignoring the presence of the ecotone. The trend in this country is for the universities to play an advancing role by encroaching on the school systems respective to what we label as inservice education. The reciprocal seems to be true in England (school-system-centered centers) where the school systems impose their wares upon the classroom teachers. What is destroyed in both cases is the fertile ground in between--the Ecotone. The philosophical orientation in both countries appears quite similar. Yet, England's school-system-controlled centers seem to be closer to providing the appearance of more open and creative involvement on the part of the classroom teachers. However, neither country is taking advantage of the human ecotone. Everyone seems to be title conscious and everyone knows who the givers are and who the receivers are. Interaction is at best superficial.

One answer may be in some form of periodic "burning" in much the same way grasslands can be burned to prevent forests from encroaching upon them. Fires are not all bad, yet this attitude is perpetuated. In terms of the establishment of the inservice ecotone, an occasional overburning might weed out a few undesirable seeds and saplings or diseased mature stock. More productive interaction between those that remain might then be possible. Controlled burning should be practiced in all the communities that circumscribe the ecotone. Such tactics need not be judged dehumanizing. There are times for burning and times for transplanting. Before the match is lit, every attempt should be made to place individuals into niches that they can fill productively. The profession has resisted such tactics because some roles within the profession are considered to be of greater importance.

Such tactics do not necessarily mean self-sacrifice. If sacrifice were necessary, it is doubtful whether we could ever switch our emphasis to a more natural orientation. It becomes more a matter of modifying our current concept of success within the profession. As stated, we are not taking advantage of the human ecotone. In this sense we are experiencing little activity within its boundaries both in a quantitative and qualitative sense. We are operating as though the inservice ecotone does not exist. In the literature there is much talk of new kinds of professional positions. Whether termed "teacher tutor" or "inservice organizer," universities and school systems have not provided the mechanism whereby their respective staffs could interchange roles or add new roles. This would be consistent with an ecotone perspective. It does little good to insist that such recommendations be followed.

In terms of resources we operate within a closed system. We have already labeled ecotones as part of an open system. We need to discourage inbreeding and encourage the exchange of staff whatever the personal risk. There are many teachers at all levels who are capable of playing new roles in the inservice realm. Provided with the challenge and an incentive they could make the difference especially in our more deprived educational systems. We need to experiment more with changing roles if even for short periods of time.

The center-ecotone comparison applies in this sense as well. The level of success we have achieved in inservice education has not been uniform. Success breeds success. The result has been continued development in regions that have taken the initiative to begin reform. Even within the same geographical area it is possible to see progressive and outmoded practices. Communication at the national level is not fostered by this kind of divergent, creative evolution. Master teachers, those who practice extended professionalism, should be given the challenge to influence their counterparts in other school systems and in other parts of the country. Movement vertically should also be encouraged. We have not been successful at playing roles or emulating those at other levels within the profession. To date migration has been primarily unidirectional—from public schools to university and not back again. It will be difficult for us to let go of our secure niches. Many of us will have to be pushed. Some will move successfully into new niches and others will be destroyed in the process. That is only natural. Each member of the science teacher profession can be said to occupy a niche, but we have bastardized the meaning of the word. Many in our profession merely occupy space and little if any selection pressure is operating. There is an obvious credibility gap and some form of eugenic approach may well be the only way to bridge it.

To develop an inservice education ecotone will require more efficient usage of the energies we have available to us. Although the analogy of the ecotone is intended to redirect our thinking respective to inservice education, no solution will be realized until we find a way to direct the process of inservice education. Possibly the best source of coordination is our own professional organizations.

Making The Ecotone Model Operational

Our organizations like AETS are self-serving although science educators rarely admit it. The point to be made here is that professional organizations should be self-serving, and we should admit it. Inservice education is a major and growing concern of AETS, NSTA and the many other professional organizations for science teachers. We should direct our organizations to govern themselves by the ecotone model. Any action by our professional organizations that will strengthen our position should be researched and, where feasible, implemented. The ecotone model should influence any decision making that would have impact on inservice education.

Any action that will cause increased activity and higher level interaction among the membership should be encouraged. Every member of the profession must become involved—some more than others, but that is natural. Currently, our professional organizations do not serve the entire profession. Some of the innovations and services introduced by NSTA and other organizations in such areas as convention design and teacher placement services are positive moves in this direction, but many science teachers still remain unaffected or even disaffected. In addition, reorganization schemes have been discussed. But reorganization by itself is not the answer, and it is doubtful that the extent of reorganization proposed will be adequate.

The science teaching profession perpetuates organizations for biology teachers, chemistry teachers and the like. We should ask whether there is need or room from the ecotone perspective for more than one organization for science teachers. There should be room within whatever structure we invent to serve all needs, not to service individual factions or groups. In our present scheme of professional organizations, too few individuals are wearing too many hats. The center orientation is very evident. This degree of unification may be a political impossibility. Yet it is possible to better coordinate the individual efforts of each organization as a possible intermediate step. One initial focus should be to convey the idea that it is an absolute necessity for science teachers at all levels to be involved in the professional organizations of the profession.

This is one answer to the problem of what is needed in inservice education, but it offers no solution. From the ecotone perspective, we must approach change in subtle, more natural ways or we run the risk of destroying entire systems. We should rather approach the problem of involving people in professional and leadership roles on an individual basis, keeping in mind that success will not be optimal until mutual associations among individuals are established. We should avoid temporary systems if established relationships are not implicit in their design. Ecotones shift and their characteristics change, but ecotones are not amenable to role playing or simulation. We should all be symbionts in the inservice realm. Unless the ecotone is visited, there is little hope of increasing the effectiveness of inservice education.

REFERENCES

1. American Association for the Advancement of Science. *Guidelines and Standards for the Education of Secondary School Teachers of Science and Mathematics*. Washington, D.C.: AAAS, Miscellaneous Publication, 1971.

2. Associated Organizations for Teacher Education. *Redesigning Teacher Education*. St. Louis: AOTE, National Invitational Conference, 1974.

3. Britton, E. "Teaching and In-service Training." *In-service Training: Structure and Content*, R. Watkins (ed.). London: Ward Lock Educational, 1973.

4. Bush, R. "Curriculum-Proof Teachers: Who Does What to Whom." *Improving Inservice Education*, L. Rubin (ed.). Boston: Allyn and Bacon, 1971.

5. Cane, B. "Meeting Teacher's Needs." *In-service Training: Structure and Content*, R. Watkins (ed.). London: Ward Lock Educational, 1973.

6. Cohen, R. "Problems of 'Retreading' Science Teachers, Part II," *Science Education*, 56:417-421, 1972.

7. Dunivan, D. "Individualizing In-service Education," *School and Community*, 11:57, 1970.

8. Fantini, M. "Teacher Training and Educational Reform." *Improving Inservice Education*, L. Rubin (ed.). Boston: Allyn and Bacon, 1971.

9. Havelock, R. "The Utilization of Educational Research and Development," *British Journal of Educational Technology*, 2:84-98, 1971.

10. Hewitt, S. "In-service Training Provision: College of Education." *In-service Training: Structure and Content*, R. Watkins (ed.). London: Ward Lock Educational, 1973.

11. Hoyle, E. "Strategies of Curriculum Change." *In-service Training: Structure and Content*, R. Watkins (ed.). London: Ward Lock Educational, 1973.

12. Jackson, P. "Old Dogs and New Tricks: Observations on the Continuing Education of Teachers." *Improving Inservice Education*, L. Rubin (ed.). Boston: Allyn and Bacon, 1971.

13. Johnson, D. *Teacher's In-service Education*. Oxford: Pergamon Press, 1971.

14. Katz, L., J. Morpurgo, L. Asper, and R. Wolfe. "The Advisory Approach to Inservice Training," *Journal of Teacher Education*, 25:154-159, 1974.

15. Koutnik, P. "Inservice Education: The Follow-through." *1975 AETS Yearbook*, P. W. Fox (ed.). Columbus, Ohio: ERIC-SMEAC, 1974.

16. Lindberg, D. "In-service Training in Science Education Methods for Teachers," *Science Education*, 55:465-469, 1971.

17. Lindsay, A. "An Inexpensive, Reliable Plan to Re-educate Secondary Teachers," *Illinois School Research*, 7:51-54, 1971.

18. Lippitt, R. and R. Fox. "Development and Maintenance of Effective Classroom Learning." *Improving Inservice Education*, L. Rubin (ed.). Boston: Allyn and Bacon, 1971.

19. Meade, E. "No Health in Us." *Improving Inservice Education*, L. Rubin (ed.). Boston: Allyn and Bacon, 1971.

20. Norman, D. "Sensitivity and In-service Training of Teachers," *Appalachia*, 4:25-26, 1970.

21. Odum, E. *Fundamentals of Ecology*. Philadelphia and London: W. B. Saunders Company, 1959.

22. Ost, D. "Humanism, Science and Education." *1975 AETS Yearbook*, P. W. Fox (ed.). Columbus, Ohio: ERIC-SMEAC, 1974.

23. Rowe, M. and P. Hurd. "The Use of Inservice Programs to Diagnose Sources of Resistance to Innovation," *Journal of Research in Science Teaching*, 4:3-15, 1966.

24. Rubin, L. "Teacher Growth in Perspective." *Improving Inservice Education*, L. Rubin (ed.). Boston: Allyn and Bacon, 1971.

25. Sherwin, S. *Teacher Education: A Status Report*. Princeton, New Jersey: Educational Testing Service, 1974.

26. Stone, J. *Breakthrough in Teacher Education*. San Francisco: Jossey-Bass, 1968.

27. Susskind, C. "'Retreading' the Science Teacher," *Improving College and University Teaching*, 18:270-271, 1970.

28. Tillis, C. and D. La Hart. "Teachers Teaching Teachers—Inservice Training in Environmental Education," *Journal of Teacher Education*, 25:160-162, 1974.

29. White, M., C. Raun, and D. Butts. "A Study of Contrasting Patterns of Inservice Education," *Science Education*, 53:13-19, 1969.

INSERVICE EDUCATION: A MODEL FOR ROLE REORIENTATION

A REACTION

Darrel W. Fyffe
Bowling Green State University
Bowling Green, Ohio 43403

Both Bernard W. Benson and Jerry G. Horn have presented thoughtful and scholarly papers on the problems and strategies for inservice teacher education in science. They seem to have accepted, without comment, the premise that inservice education is necessary. This premise could easily be backed with convincing comments since, as Benson says, an "interesting observation about inservice education literature is the conviction with which the authors write" (p. 156).

However, an intriguing point of view arises when we consider that one of the ultimate goals of education is the development of the ability and desire to continue the learning process independently. If teachers, having been once "educated" in their pre-service schooling, have acquired that ability, then why should they require the talents and time of others (at any level) to "inservice" them? The answer, of course, is that efficiency in time and learning can best be developed when expert knowledge and skills are brought directly to each consumer. We each might be able to discover the necessary understanding independently but the time and resources required would be prohibitively extravagant.

This point of view, that inservice education of teachers in science by persons possessing expertise is necessary, leads us to the development of a definition of inservice education. Drawing upon the language of Hewitt (1:41), inservice education shall be termed "any structured educational experience undergone by a teacher . . . which (is) specifically designed to improve the professional expertise and competency of serving teachers." This definition is intentionally narrow in outlook, eliminating the effects of "experience" as a teacher, incidental learning from outside influences, and personality development through maturation.

Now, using that definition, let us look at some major points expressed by Benson and Horn. First, Benson expressed a view that inservice education leaders say "we" are "concerned . . . about not instilling our own values upon classroom teachers" (p. 161). It would appear that this feeling, if it does exist, is in conflict with the avowed purpose of inservice education. The improvement of professional expertise and competency in a structured experience implies the existence of professional "values" which are possessed by the agency which is structuring the experience. It would be folly to encourage inservice teachers to not try to be accommodative of these views when presented. It would be professional incompetence for the agency to not possess skills, knowledge, and professional "values" which enrich the practicing teacher.

The agent which is responsible for inservice education of teachers in science, though, is the central point of both papers. Horn concludes that regional centers, which have rather specific responsibilities, and the directors of those, who have extensively defined backgrounds, will assume the responsibility. He compares and contrasts these centers with the "teacher's centres" of England and those of other nations.

Benson, however, gives the responsibility of inservice education to professional organizations. These organizations would govern the practice of inservice education by what he calls "natural laws" of a professional ecotone. His model requires the consolidation of several existing organizations into one which admits to being self-serving for the professional betterment of its members.

Neither Benson nor Horn is lacking in good ideas. The consolidation of the several professional science teaching organizations into a powerful and funded "one" might be good. One thinks of the benefits of membership whenever the American Medical Association is mentioned in professional medicine. Similarly, the legal profession is well represented. Both these bodies of professionals, because of consolidation as opposed to fragmentation, are extremely well prepared to handle their professional problems. They virtually control the pre-service and in-service education of their members. They control their destiny to a far greater degree than could any one of the present melange of science teaching societies.

Of course, if unification of science teachers is desirable, could we also argue for unification of all those connected with the field of education? The impact upon the profession is uncertain but potentially great. Rather than disagreeing among ourselves and working at duplicate meetings and services we could spend energies on aiding and inservicing one another.

Who will take the lead in uniting these factions? Good question! The professional expertise of educators certainly should presently include some individuals with the determination and/or charisma to bring about the move. Until we can recognize those persons perhaps we must be content to implement the centers as espoused by Horn.

Movements are already underway to develop cooperative relationships for both the pre-service and in-service education of all teachers in Ohio. The State Department of Education has suggested that cooperative agreements by local school districts, teacher education institutions, and the Department will be required in the near future. These contracts will essentially develop the teacher education centers as suggested. Funding from State resources for teacher education would be channeled through these centers.

The question of who is responsible for the inservice education of teachers must recognize the conflicting points of view and areas of concern of the teachers, administrators, universities, teacher's associations, and school boards. Teaching centers should draw upon the strengths of all these factions. This plan uses the "growth" approach which was described by Jackson (2:26-28). It must be recognized that inservice education programs should be developed and taught by a team of competent individuals, not all of whom are university staff members.

Inservice education should be increasingly based upon local and individual needs. The wider use of educational technologies will aid in this goal. Horn had spoken to this point with special concern for the sparsely populated areas of our nation. These areas exist in many states, with perhaps a small proportion of the nations teachers but encompassing large areas of the country. The needs of these professionals can, many times, only be met with exceptional efforts.

Efforts must be initiated to implement plans for the improvement of inservice education. These efforts must take into account the need and value of having professionals, at all levels, participate in their own enrichment. Each professional must be encouraged to participate fully in activities and organizations which have as goals the betterment of teaching. Perhaps, in this way, the strong base will be established which is needed to elevate the inservice education of teachers in science.

REFERENCES

1. Hewitt, S. "In-service Training Provision: College of Education." In-Service Training: Structure and Content, R. Watkins (ed.). London: Ward Lock Educational, 1973.

2. Jackson, P. "Old Dogs and New Tricks: Observations on the Continuing Education of Teachers." Improving Inservice Education, L. Rubin (ed.). Boston: Allyn and Bacon, 1971.